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The Staggering Cost of Modern Warfare

By Albert A. Hopkins

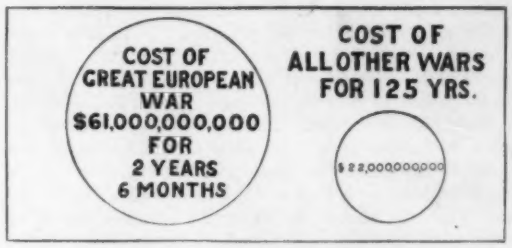
NOW that we are facing a $7,000,000,000 loan and a war tax which bids fair to reach into the pockets of every man, woman and child in the United States, it is interesting to see how far money really goes in actual warfare. The real cost of the war will never be known—it is incalculable. The loss of human life and the loss of efficiency by wounding or blinding, the loss of productive industry caused by diversion to the arts of war, the disorganization of international trade, the destruction of property, are a few of the factors that are beyond the practical ken of the statistician. It is reasonably possible to make a fairly close estimate of the direct cost as represented by loans and taxes.

At the beginning of the World-War, no one would ever have suggested that in three days the terrible waste would equal the cost of constructing another Panama Canal, but this is the case. Every day enough money is spent to erect seven Woolworth Buildings.

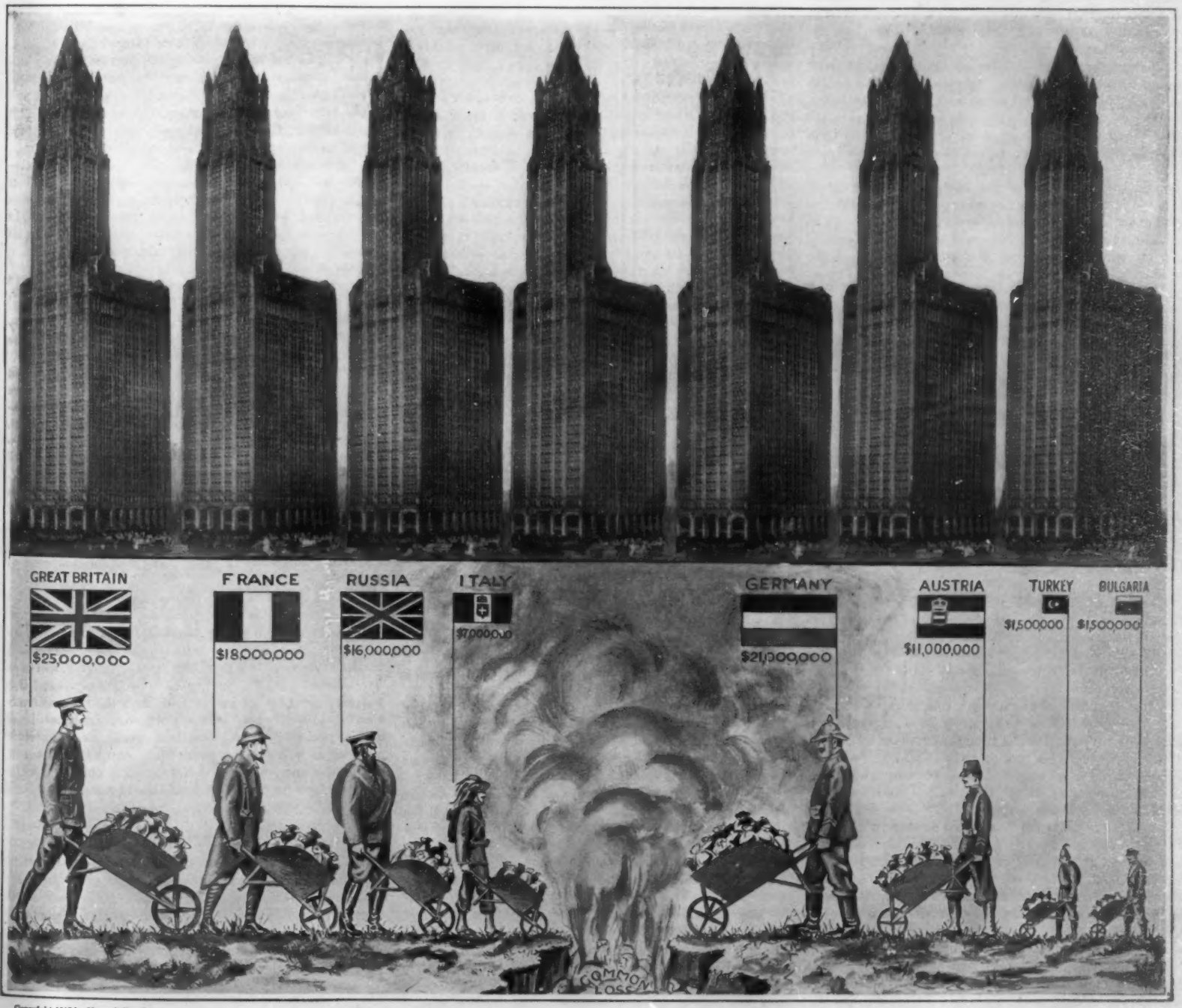
The aggregate direct cost of the twenty greatest wars in the century and a quarter preceding the outbreak of the present struggle, was not in excess of $22,000,000,000.

To the end of 1916 the direct money cost of the Great War totaled, according to the most reliable figures available, those of the *New York Times*, over $61,000,000,000, and expenditures are now at the rate of no less than $105,000,000 a day. The figures for the principal nations involved are given here:

Country	Total cost to Dec. 31, 1916	Present average cost per day
Great Britain:		
United Kingdom	$14,374,000,000	$23,500,000
Canada	400,000,000	900,000
Other colonies	600,000,000	600,000
Total Great Britain	$15,374,000,000	$25,000,000
France	$12,200,000,000	$18,000,000
Russia	8,500,000,000	16,000,000
Italy	4,000,000,000	7,000,000
Belgium	490,000,000	1,000,000
Serbia	330,000,000	1,000,000
Rumania	250,000,000	2,000,000
Entente Allies	$41,144,000,000	$70,000,000
Germany	$14,600,000,000	$21,000,000
Austria	5,000,000,000	11,000,000
Turkey	650,000,000	1,500,000
Bulgaria	375,000,000	1,500,000
Central Allies	$20,625,000,000	$35,000,000
Grand Total	$61,769,000,000	$105,000,000



Cost of the present war compared with that of other wars



The daily cost of war would be sufficient to build seven Woolworth Buildings

EUROPE'S DAILY SQUANDERING OF TREASURE $105,000,000

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Submersible Freighter Versus the Submarine

AMERICA gave Germany the submarine; and by the irony of fate, Germany has given to America an effective answer to the submarine in the submersible freighter "Deutschland." The American inventor never dreamed that the German, or anyone else, having possessed himself of the new weapon, would turn pirate and run amuck among the shipping of the world. It is equally true that, when Germany sent the "Deutschland" to America, she must have overlooked the fact that she was providing in that peaceful merchant ship an absolute answer to that twentieth century piracy, upon which, by Germany's own confession, depends her one last chance of winning the war. As we remarked in these columns during a recent talk about the submarine, it sometimes happens that the solution of a problem is so simple and self-evident that we overlook it altogether; and here, surely, we have a case in point.

What is it that makes the submarine such a fatal enemy to the surface craft? Obviously it is the invisibility of the one and the clear visibility of the other. So long as the enemy can see you and you cannot see him—that is to say, so long as he can strike at you from ambush, you are at an enormous disadvantage; and you can meet him on even terms only when he is just as much exposed to your vision as you are to his. This disadvantage is fundamental. It will be present so long as the hunter is below the surface and his prey is above; and no amount of ingenuity, expressed in terms of scientific and mechanical appliances, can effectively restore the balance. It was when the fighting craft went below the surface that it took on its deadly efficiency, and manifestly, the only answer for the merchant ship is to follow suit by going below and thus opposing invisibility to invisibility. Thus, and only thus can the world's peaceful shipping regain the freedom of the seas and pass unhindered from port to port.

We all remember how futile were the early attempts of the British to resist the aerial raids of the Germans by attacking them from the ground—that age-long theater of all military operations. It was not until they realised that the aeroplane and the airship could be fought successfully only in their own element, the air, that they sent the Zeppelins flaming to earth and swept the German aircraft back behind their own lines.

So, in this submarine crisis, it is folly to expect successfully to fight submarine craft with craft on the surface, or successfully to send a surface merchant ship through waters that are swarming with these invisible sharks of the sea. Just as aerial navies must be fought with aerial navies, so the menace of the invisible sub-surface craft must be met and neutralized by setting afloat an invisible merchant navy. Unless the present expedients for combatting the submarine develop in the near future far greater efficiency, we should commence the construction of a fleet of submersible freighters, so that we may be prepared to meet the profound crisis which will arise when the conviction is brought home, as we believe it may very soon be brought home, that to continue building surface ships, whether of steel or wood, and sending them out on to the high seas, is merely to send them like sheep to the slaughter.

But can the thing be done? It most certainly can, and Germany has proved it to a demonstration in the two successful voyages of the submersible freighter "Deutschland." Nay, the task of running a 5,000-ton submersible across the Atlantic, where its only risk would be the one in one hundred chance of its conning tower being sighted from the conning tower of an enemy submarine, would be simple compared with the task confronting Captain Koenig, who passed through seas that were swarming with fast, heavily armed surface craft of the enemy.

But can a fleet of large submarine freighters be built swiftly and economically? Could they be successfully navigated; and could they submerge and maneuver with facility? They could, and in our following issue we shall give some plans of a type of freighter of 5,000 tons displacement, which could be built at the same cost as a surface ship of the same size, and which would be able to repeat the voyages of the "Deutschland" with safety and certainty, and on a schedule which would be subject to no delays.

United States Patents Owned by Germans

THE war finds us with many United States patents owned by German subjects. Some of these patents have been granted on devices and processes the use of which is absolutely necessary to the health and safety of our people. While the liberal policy of our Government with reference to patents should be continued, the necessity is becoming more and more apparent that some provision should be made in our Patent Laws which will legalize the use of patented inventions when industrial progress and public safety require.

It is not necessary or advisable to revoke patents owned by German subjects. If the manufacture under such patents is not carried on to meet the requirements of our people, the right to manufacture in the United States may be legalized, and the patents owned by alien enemies could remain in force without jeopardizing the public safety or industrial progress. If licenses were granted authorizing the manufacture in the United States under such patents during the war, and for such longer period as may be necessary, the situation would be immediately cleared. The law could provide for the grant of licenses by a court after a public hearing, the court to determine the amount of the royalties, which might be held by a trustee until the termination of the war, when the manner in which the royalties would be disposed of might be determined.

By such an amendment to our Patent Act, not only would the use of the inventions by our citizens be legalized, but it would be possible to hold the royalties, which might be paid to the owners of the patents on the termination of the war under such conditions as our Government might deem proper.

Build It in Marble

THE destruction by fire of the clock tower of the City Hall, New York, so far from being a disaster is rather to be regarded as presenting an opportunity for greatly improving the beauty and dignity of that famous historical landmark. The City authorities did not follow the plans of the architect of the building and the clock tower, as built, did not compare in architectural excellence with the cupola as originally planned. The original design, both as regards its details and its total height, blended more harmoniously with the exquisite lines and proportions of the City Hall than the clock tower with which New Yorkers are all so familiar. We understand that it is proposed, in rebuilding, to revert to the original design and we sincerely hope that this will be done. If so, timber should be discarded altogether and the cupola should be constructed in marble, preferably marble taken from the same quarry as the stone of which the City Hall is built. Fortunately, the location of the cupola is such that its north and south walls rest upon the interior heavy walls and columns of the building, and if steel girders were laid between these supports to take the load of the east and west walls of the cupola, a satisfactory foundation would be provided. Here is an opportunity for the City Fathers to put through a work of architectural embellishment for which future generations will rise up and call them blessed

Oils and Fats in Germany

GRADUALLY all the leading necessities of life in Germany have been officially centralized for economic reasons, it having been found that the necessities of a state of war could no longer countenance free buying and selling of such commodities. It took some time to carry out the whole of the official program and, at first, some murmuring was encountered; but, at the present juncture, the wisdom of the course taken has been generally recognized and readily accepted. These remarks are especially applicable to the case of oils and fats.

First of all special attention was given merely to the requirements of the military; the quantities needed for the army and navy were secured and the civilians were left to purchase all they needed in the open market. However, as the war dragged on this became impossible and, in February, 1915, the "War Committee for Vegetable and Animal Oils and Fats" was formed in order to buy up all the requisite raw materials and control the just distribution of all existing stocks. The committee's first step was to prepare statistics as to production and consumption. The most careful estimate possible was made of production, export and import, and this led to the conclusion that Germany's annual consumption of vegetable oils was 560,000 tons, and of animal fats, 1,900,000 tons.

Of the latter some 430,000 tons went into technical uses, and it was here that the firm effort at economy was made. The War Committee succeeded in reducing this consumption to 40,000 tons. The industrial world was called upon to assist to the utmost by employing substitutes wherever feasible; the apothecaries, druggists and chemists agreed to a system of rationing their supplies; and a similar restriction was adopted by the Catholic churches in connection with their supplies of illuminating and sacramental oils.

But the most difficult problem of all was the restriction of these materials in connection with the food of the people. Although many other peoples can do with less fat than the Germans, the climatic conditions are different. Then, too, the Teuton method of living gives such an important rôle to carbohydrates that any comparison in this respect is hardly fair. It is also impossible to feed a nation according to fundamental principles applied to catering for prison camps and the like. Hence fatless days were introduced; the consumption of fats in kitchens, restaurants and preserve factories officially curtailed; the use of cream was forbidden and many other similar orders were issued in quick succession. All this, however, proved insufficient; finally, it became necessary to confiscate all oils and fats whatsoever and the whole nation was place on short rations.

A very large quantity of fat and grease was saved by the introduction of the laws controlling the manufacture of soaps. Right now Germany has found substitutes for all of the normal soap-making fats and oils of peace time except a bare 7 per cent. Of course, the war soap is not to everybody's taste; it contains too much clay, moss, etc., for that; yet it is usable, and effects a great economy of carbohydrates.

A second important regulation dealt with the supply of resin which, of course, plays a very important part in the varnish, paint and paper industries. As imports had ceased it was necessary to take other steps and, first of all, all suitable trees in Germany were tapped. This year resin has been collected wherever possible, not only in the Fatherland (about 60,000 acres available) but also in the occupied territories. It is believed that in this way sufficient resin will be secured to meet most, if not all, of the most pressing requirements; this will enable Germany not only to carry out her soap program, but will also be of very great assistance to her paint and paper industries. This important experiment, the first of its kind in Germany, has so far proved satisfactory. It was no easy task to obtain all the plates, metal sheets, and iron accessories required; still it was managed—somehow. The varnish industry has found a further aid in the form of Cumaran resin, a product obtained by washing heavy benzole with sulphuric acid. In itself it has but little in common with resin, but its action is very similar and it is also peculiarly adapted for use in the varnish trade.

Another obvious expedient, of course, was the recovery of oil and fat from waste and from sources never before utilized. Large acres were sown with sunflowers, poppies, and other oil seed plants. Beech nuts and other oil-bearing products of field and forest were systematically gathered, mostly by school children. A systematic collection of bones has gone on.

The experiment made in 1915 with fruit kernels did not hold much promise; but in 1916 better results were obtained. It was at first difficult to find suitable machinery for crushing the kernels without spoiling the oil. The Biehnert Mills at Dresden finally succeeded in satisfactorily solving this problem, so that the collection of kernels will be actively proceeded with throughout 1917. A further rich source for the supply of oil has now been discovered in maize shoots which are removed and the oil extracted; the same thing is being done in the case of sprouting rye and barley.

The utilization of fatty yeasts has so far not yielded much result. This year, however, walnut and grape kernels are to be used for yielding oil, and fats are also to be extracted from glue leather (glover's clippings and furrier's waste), All raw beef and sheep fat will also be collected. So far no less than 4,000 so-called "fat-cutters" are at work in Germany and the occupied territories. To all these methods we must finally add the recovery of oils from the seeds of weeds, and also from asparagus, ash and acacia seed, acorns, chestnuts, diatomic slimes, fish, fish waste, mineral oils, etc., while fats will also be extracted from drainage sediments and the like.

Submarine Attack and Defense

IN their efforts to hit upon a solution of the submarine menace, many American inventors have been working in the dark. In early issues of the SCIENTIFIC AMERICAN we shall endeavor to shed light upon the problem, giving data in regard to torpedoes and submarines, and stating why certain frequently proposed means of defense are inadequate. In this connection we wish to acknowledge with thanks letters from our many friends upon this subject. Too numerous to make individual reply possible, all suggestions of value have been and will be forwarded to the proper authorities.

Naval and Military

Germany's Shipping Losses.—An estimate by one of the Government Departments in Washington, indicates that Germany will have lost no less than 50 per cent of her merchant shipping at the war's end. In detail, it is estimated that Germany has lost by mines or torpedoes 452,000 tons of shipping; that the amount retained or captured by enemies, excepting the United States, represents a total tonnage of 807,000. The loss to the United States and in neutral harbors represents a total tonnage of 2,341,000. In the home ports of Germany there is a total of 2,410,000 tons.

War-time Operation of Railroads.—The direction of our Continental railway system during the war has been placed in the hands of an Executive Committee of the special Committee of National Defense of the American Railway Association. The plan of operation covers all of the railroads, both on behalf of the public as well as of the Government. Under this system the Government will advise the railroads as to what service it requires, and the responsibility will be upon the railroad managers to provide that service. To this end the railroads of the country will be operated practically as one system. It is believed that the transportation companies will be able to afford to the Government, expeditiously, all the service it may require, without substantial interference with the commercial business of the country.

Sails versus Coal.—We gather from a French contemporary that not only in this country but in Europe are wooden ships being turned out in considerable numbers. Thus, in France it is proposed that the supplies of timber in forests adjoining the big seaports be used for the construction of either all-wood or of composite ships—that is to say, ships with wooden planking laid over steel framing. Another interesting development, due largely to the high price of coal, is the activity in the construction of wooden sailing ships. With coal at $50 per ton, which we understand is the price which it has reached in Italy, the substitution of sail for steam has decided economic reasons to justify it. Moreover, not only is coal high but the price of lubricants has risen, and some of the shipmasters are favoring a type of auxiliary vessel, using both sail and power.

United States Adopts the Enfield Rifle.—The Enfield rifle is being manufactured in large numbers in this country for the supply of the British troops, and, because of our complete equipment, the War Department has decided to adopt the Enfield rifle for the forces which we are intending to send to Europe. The present capacity is about 950,000 Enfields per month, and according to dispatches from Washington, the Government, if it wishes to use the production of all the rifle factories in the United States, could provide 3,000,000 rifles for its army within three months. The War Department is also going to adopt the types of heavy field artillery which have been built for the Allies in this country and have proved so destructive on the Western front. The Enfield rifles will be rechambered to take American ammunition; otherwise the pattern will remain the same.

French Aeroplanes for the Army.—A dispatch from Washington states that because machines of American manufacture have failed to meet the War Department tests, contracts for supplying our new army will be placed abroad. An order for 1,800 French machines it is understood has already been given, and this will be followed by later contracts. So essential is a first class aerial equipment for the success of modern military operations, and so urgent is the call for our army in Europe, that it has not been possible to await the development of thoroughly suitable military aeroplanes in this country. The machines must be ready as soon as the army is ready; moreover, the airmen must have had thorough preliminary training with the types of machines which they will use in battle. Each man has two machines, with a third in reserve; which means that a total of over 3,000 French aeroplanes will be required within the next few months.

Contribution of Big Business to the War.—Very inspiring has been the patriotic attitude of what has generally come to be known as big business in the United States. In several notable cases, such as that of Charles M. Schwab, great industrial establishments have been placed freely at the disposal of the Government. Particularly gratifying, and representing enormous economy in the conduct of the war, was the action of the steel industry of this country taken at a meeting held in the offices of the United States Steel Corporation, when the foremost steel makers of the country agreed to supply steel to the Government during 1917 at less than half the market price, and to appoint a Clearing House Committee which will apportion contracts in accordance with the best interests of the Government. Plates will be sold at the price of $2.90 base a hundred pounds, and structural shoes and bars at a price of $2.50 base. Plates are now quoted at $6.00 a hundred pounds in the open market.

Science

Gardens Injured by Street Sweepings.—The Department of Agriculture has called attention to the fact that in using street sweepings to fertilize gardens, care should be taken to avoid material containing oil and tar, as both of these substances are harmful to plants. This caution is necessary in view of the practice of tarring pavements and oiling roads, and the frequent presence of oil droppings from automobiles. An instance is cited in which a garden was ruined by the tar products in the fertilizer, so that it was necessary to remove the top soil and resurface the entire plot with new soil.

Epidemic Cerebrospinal Meningitis.—Under date of May 5th, the Public Health Service reports an unusual prevalence of cerebrospinal meningitis. The service states that the occurrence of the disease in epidemic form at this time is of particular importance, since this disease is one that frequently gains entrance to and spreads in encampments of troops. The chief known foci of the present outbreak have been in Philadelphia, Cleveland, St. Louis, Hartford and Minneapolis. In Philadelphia 237 cases have been reported since the beginning of the year.

Clock-Dial Adjustable for Summer Time.—Instead of moving the hands of the clock forward and back at the time of changing from standard to summer time, and *vice versa*, a plan recently proposed in England is to have clocks provided with an adjustable dial. The circular disk of the dial would be put in place by screws in curved slots, and the dial would be rotated through one hour space at the time of making the change, leaving the hands untouched. This plan is especially desirable in the case of striking-clocks, the hands of which cannot be moved back. The position of the dial would also indicate whether the clock was keeping summer or normal time. The objection to this procedure, of course, is that practically everybody tells time from position of the hands, without any attention to the figures on the dial. Only trial can tell how serious a drawback this will constitute.

Coconut Butter.—The American consul at Trinidad, Mr. Henry D. Baker (an official whose observations in various parts of the world have yielded an altogether unparalleled amount of interesting information), reports that the Department of Agriculture of that colony is promoting the household manufacture and use of coconut butter, while the local newspapers are also urging the development of this local resource. From four large coconuts it is possible to make a pound of butter, which, unless kept too long, is said to be as rich as the best creamery butter, from which it can hardly be distinguished, except by a slight and altogether palatable flavor of coconut. This is a matter of great importance to the West Indies, where coconuts grow in great abundance (and few economic plants are more prolific of fruit), while the dairy butter is nearly all imported in tins, mainly from Denmark. At present, with limited shipping facilities, ordinary Danish butter costs 50 cents a pound in Trinidad, while superior grades sell at 65 cents.

Animal Indicators for Hydrocyanic Gas.—The instructions of the Public Health Service for fumigating vessels with hydrocyanic gas require that, after fumigation, a captive animal, such as a guinea pig, rat, cat, etc., shall be lowered into the hold to test the state of the air before human beings enter. The desirable qualities in the test animal are that it shall be easily obtained and handled, and that it shall promptly show visible symptoms when breathing the gas in considerable dilution, but shall not die soon after showing symptoms. The Service has carried out a series of experiments to determine which animals are most suitable for this purpose. It is found that sparrows or other small birds are the most delicate live indicators, but die almost immediately after showing symptoms, and they are not recommended for routine work. Mice or tame rats are almost as susceptible as sparrows, and are probably the best test animals available. Cats are sufficiently susceptible, and with care the same animal may be used several times. Guinea pigs are quite resistant to the effects of the gas, and should never be used when rats are available.

The War's Toll of Medical Men may be gaged from a recent statement of the Earl of Derby that in the battle of the Somme alone, over four hundred doctors were either killed or wounded. A praiseworthy movement is now on foot among the medical colleges of the United States to keep up the supply of doctors, by encouraging medical students to complete their courses, rather than to enlist in their undergraduate stage, and also by discouraging the serious depletion of the faculties to supply the army. The Medical School Committee of the Medical Board of the Council of National Defense has drawn up a series of recommendations, urging, among other things, that "this country should not repeat England's blunder at the outbreak of the war in permitting the disorganization of the medical schools, either by calling the faculties into active service or by sanctioning the enlistment of medical students into any of the line organizations."

Electricity

An Electric Concrete-Surfacer.—Consisting of a cutting tool driven through a flexible shaft by an electric motor carried by the operator, an electric concrete-surfacer is among the latest electrical labor-saving devices. The cutting tool consists essentially of a disk on which are mounted sixteen hardened-steel cutter wheels, the latter rolling on the surface to be dressed in such a manner that their teeth remove the material by the chipping action.

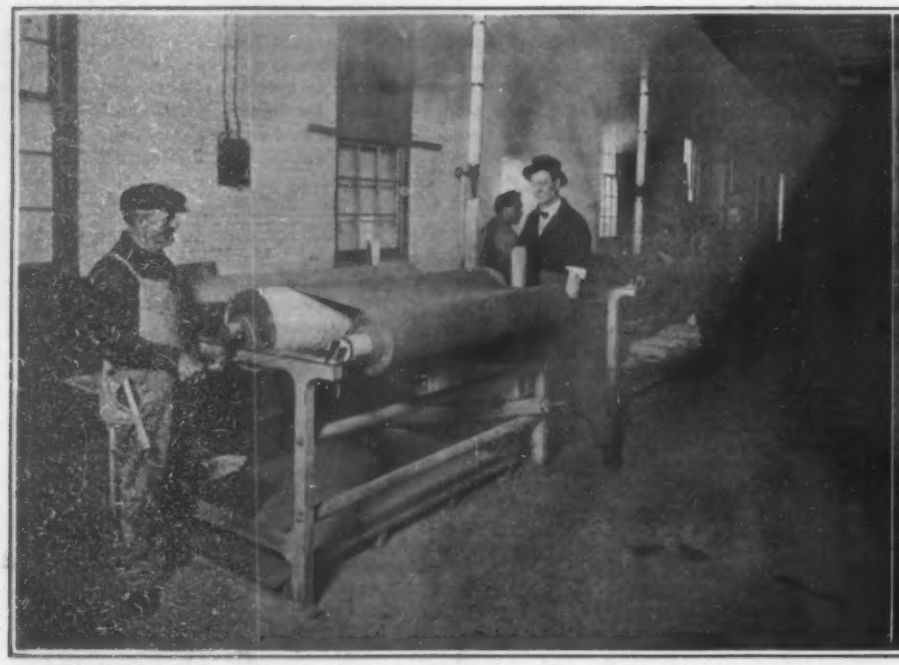
The Award of the Edison Medal.—The seventh Edison medal, states the *Electrical World*, which was awarded to Nikola Tesla on December 13th, 1916, "for meritorious achievements in his early original work in polyphase and high-frequency electric currents," was presented to Mr. Tesla at the annual meeting of the American Institute of Electrical Engineers in the auditorium of the Engineering Societies Building, New York, on May 18th last.

Making the Telephone More Efficient.—In order to keep disturbing sounds out of the ears and to amplify the sound, particularly in the instance of long-distance calls, there has recently been introduced a device which can be used with the ordinary telephone instrument, but which is not an attachment, and therefore cannot be objected to by the telephone companies. This device consists of a sound chamber over which is placed the telephone receiver instead of putting it up to the ear, and two adjustable hearing tubes. Simple means are provided for fitting the tubes to the individual, thus leaving his hands free.

Hair Drying with an Electric Comb is another comfort that electricity has bestowed upon us of this enlightened twentieth century. An electrically-heated comb, the entire metal part of which is made of a single die casting, is now available. The novel construction of this comb makes possible the use of a flat heating element and eliminates the necessity for enlarging the back of the comb. The 30-watt heating element can be placed near the teeth of the comb, making for greater efficiency in transforming the small current consumption into applied heat.

Unprecedented Demand for Flashlamp Batteries.—Never before have the manufacturers of flashlamp batteries experienced such prosperty as they are enjoying at the present moment. Indeed, it has been said that for every battery they can produce there are three buyers; in other words, the demand exceeds by 300 per cent the present output. There is very little demand for cases, however, the present business being in the nature of renewals. Since the flashlamp is indispensable to the modern soldier, it is likely that the present demand will be still further increased when our American legions take to the field in the near future.

Electricity and the Submarine Problem.—Among the thousands of ideas that have been made known during the past few weeks with regard to the submarine problem, many of them have been based on the use of electrical devices in some form or another. These schemes have ranged all the way from the use of powerful electromagnets for attracting the submarine to its doom, to the use of electrical "ears" or microphones for the detection of the underwater raider. It is apparent that many of the persons working on such anti-submarine devices are sadly lacking in electrical knowledge; for otherwise they would not waste much time on some of the ideas they are attempting to develop. For instance, the man who contemplates attracting submarines by means of electromagnets should know that the field or flux of even the most powerful electromagnet is a comparatively local one: it does not extend for any appreciable distance. Only in the event of the electromagnet actually coming in contact with a submarine hull would the device be of any use, and even then it is doubtful if the electromagnet employed would be sufficiently powerful to hold on during the raising of a struggling underwater craft weighing many tons even in the water. But the electromagnet has possibilities; conceivably it might serve to attach a cable to a submarine, and in this way enable a bomb fitted with a trolley to be slid down the cable and exploded against the steel sides of the enemy craft. There must be many applications for this device which are out of the ludicrous class. Another electrical method whose suggested application indicates a sad lack of knowledge is that making use of the ocean as an electrical conductor. It is held that any difference in the conductivity of this medium, such as the passing of a submarine between any two electrodes spaced some distance apart, would be indicated on a sensitive galvanometer. But has the inventor stopped to consider what an excellent conductor is the ocean with which he is dealing? Hardly; for if he did he would know that a submarine would not create any appreciable difference in the conductivity of the ocean. However, the inventor who is experimenting along the lines of the electrical "ears" is most likely working along sane lines, for there is much promise of practical results in this direction.



Because of this steam treatment to which the fabric is first submitted, the Army uniforms will not shrink no matter what service they may have to render

On tables 200 feet long the cloth is spread out, layer after layer, until the pile is 30, 60 or 100 ply

Army Uniforms by the Millions

What Fifteen Thousand Uniforms a Day Means in the Way of Labor-Saving Methods and Machinery

NO matter what may be said regarding our military preparedness in other directions, one thing is certain at this very moment: our soldiers, as fast as they are mustered into service, and no matter in what numbers they may come, are going to find uniforms awaiting them—not elaborate uniforms to be sure, but neat, comfortable, well-fitting and practical clothing in almost limitless quantities. Indeed, if every other problem connected with the preparing of an army of two million men were as readily solved as the clothing problem, American troops would no doubt be in a position to deliver a crushing blow at the common foe in short order. However, and unfortunately, such is evidently not the case.

Borrowing a leaf from the automobile industry, American clothing manufacturers have introduced labor-saving devices and quantity-production methods which rival those found in any other field of endeavor; for instead of making the uniforms one by one as in days gone by, the present uniform tailors are turning out their handiwork by the thousands. Machinery is being employed to an unprecedented extent, and a visit through any one of the several plants engaged in this class of work usually brings to mind our automobile industry which similar methods have made possible.

"Somewhere in New Jersey" a typical plant is turning out Army uniforms at the rate of over 15,000 every working day, representing the work of some 3,000 operatives. Here the cloth, a yard or so in width, is received in the form of rolls or bolts direct from the weaving mills. But before the cloth can be converted into uniforms it must be examined; so yard by yard and mile by mile the khaki fabric is passed over a perch in order that each and every square inch of surface may come under the critical eye of the cloth expert. Thus the defects in the weave are detected at the very start of operations, and cannot make their way into the finished product.

Still another indispensable operation is the shrinking of the cloth. In order that the soldier, after his first exposure to the rain, may not find himself half clothed in what was formerly a full-sized, perfect-fitting garment, the cloth is subjected to utmost shrinkage. Two methods are employed toward this end. The first and newer method is to pass the cloth over rollers while exposing it to high-pressure steam, which results in the rapid and thorough shrinkage of the fabric. The second method is Nature's own procedure; the cloth is dipped in tanks of cold water and then allowed to dry. This is a somewhat slower method, although it is still followed.

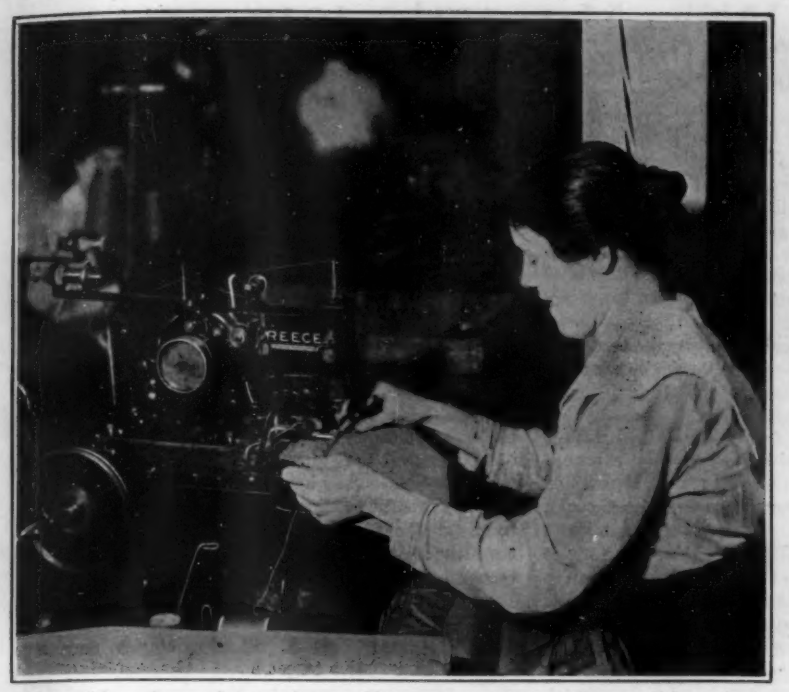
Carefully inspected and thoroughly shrunken the cloth is now ready for the cutting room, where it is laid out on cutting tables 200 to 250 feet in length. Not so long ago the cloth was laid out by hand: four men—two on each side of the heavy roll of cloth and two straightening out the strip being paid out—were required to lay out the fabric. Efficiency methods, however, have disproved of this practice, and today, with the aid of a special machine, one man can do the same work in a fraction of the time formerly required by four men. The machine which does this work takes the roll of cloth and pays it out over a number of rollers which straighten out all wrinkles. The operator merely pushes the machine from one end of the cutting table to the other and back again, repeating the operation as many times as necessary to pile up the requisite number of layers.

Then come the patterns, which are either in the form of paper designs to be laid on top of the fabric, or chalk marks on the top layer, which are made by means of a template; but in either event the work is now ready for the rough cutting. This operation is undertaken with individual cutting machines consisting of a razor-like blade driven rapidly up and down by a small electric motor, in a manner suggesting the jigsaw. These machines are dexterously manipulated by the cutters, who pilot them through the dense sea of fabric spread out on the cutting tables. Of the fairly thin material these small machines can cut up to 100 thicknesses, although that number is seldom attained in the usual work; indeed, 30 to 60 layers appears to be the regular run of work.

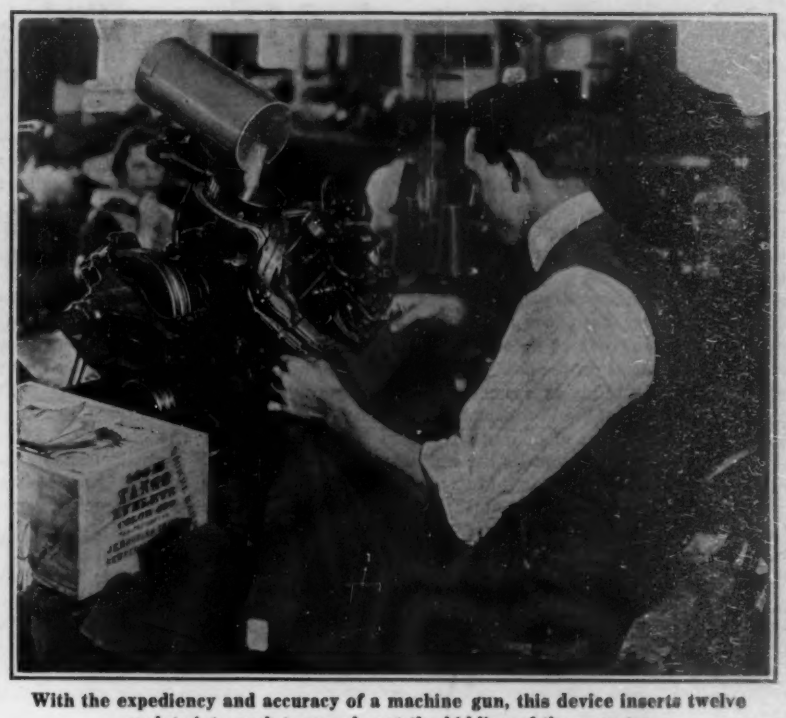
Following the rough cutting, the piles of fabric are moved down the table toward the larger cutting machines with which the more delicate trimming is done. These machines, unlike the smaller ones, are not moved about; instead, the small bundles of cloth are manipulated about a razor-like band which travels vertically through the center of the table, after the manner of the conventional band-saw. Up to 300 thicknesses of thin material can be cut with these machines, although 100 appears to be the usual run of work on heavier material; and because of the comparatively light weight of the piles of goods, the finer class of cutting can be readily accomplished in this manner, while with the smaller cutters many pounds of metal must be wielded in and out of the fabric, following the outline of the pattern.

The rough cutting of the layers of fabric is accomplished by means of individual jigsaw cutters, guided by the skilled workmen

Following the rough cutting, the piles of fabric are trimmed to shape with this machine, which is virtually a band saw



Motor-driven, heavy-duty sewing machines such as this one play an all-important part in the making of 15,000 uniforms each working day



With the expediency and accuracy of a machine gun, this device inserts twelve eyelets into each trouser leg at the bidding of the operator

The various bundles of fabric are marked for style, size and the part of the garment they represent, after which they are ready to be assembled and sewed into uniforms. The work of sewing is largely done by girls, and, aside from the fact that heavy duty sewing machines are used, follows usual practice. One instance of the labor-saving methods employed is an eyelet machine, which inserts twelve eyelets at the bottom of a trouser leg in one operation.

With the sewing completed, the uniforms are sent to the pressing department, where they are finished in the conventional manner, after which they are carefully inspected and then sent to the shipping room, ultimately to find their way to America's coming legions of fighting men.

Making Flags for Our Warships

THESE are busy days at the New York Navy Yard at Brooklyn—busy alike for the machinists, the electricians, the bluejackets, the officers and last of all, the flag-makers. It is here that the master flag-maker and his corps of assistants are busy cutting and making flags to supply our warships, Army posts and all the various Government buildings on the Atlantic coast. A small factory in the Mare Island Navy Yard supplies the flags needed on the Pacific. The United States Government has made its flag-making department an efficient, modern factory, for such it must be to turn out the flags for the hundreds of our naval vessels. To obtain an accurate idea of the extensive array of flags for official occasions, one has to see a warship in gala dress. In this ceremonial outfit alone each ship carries about two hundred and fifty flags, costing $2,500.

Each battleship carries more than forty foreign flags, 25 by 13 feet. While the Government insists on using the best of bunting for these flags, weather and frequent use wear them out in time, so that there is a provision that each ship must have a complete new flag equipment every three years, and oftener if needed. The Government is extremely careful in selecting the bunting for its flags. Practically all of it is wool and 19 inches wide. Before it is accepted it is given a chemical and a physical test to determine its strength and quality. Flag-making as the Government does it, calls for a prodigious amount of work. More than four hundred distinctive kinds of flags are made. Many of them involve patient labor. The sewing room at the New York Navy Yard presents an interesting and patriotic spectacle. Here, in a great blaze of color, many skilled machine sewers and needlewomen stitch at the fantastic flags of the world, with sometimes the dragon of China falling over against the white elephant of Siam or the prancing horse emblazoned on the ensign flag of Venezuela, or the lone star and crescent of the Turk.

Flag outfit of a United States battleship: 250 flags which cost $2,500

The first operation in making a flag is to cut out the flag from measurements arranged on chalk lines and metal markers on the floor. The first basting is usually done on the floor also, as large stripes and like pieces can be more conveniently stitched in this way. The final sewing on all the flags is done on machines. In recent years flag-making has become highly specialized. At the present time each woman is kept working on the flag part that she makes best. Some excel in "trimming" stars, others in striping and some in a complicated emblem on a foreign flag.

The many thousands of stars used on "Old Glory" each year are cut out by a cutting machine which manages the eight different sizes needed. The stars on the reverse are simply pieces of cloth basted to the blue field. An operator using a "zig-zag" machine stitches around the edge of the star which has been cut out by machine; this makes a star pattern on the piece of cloth basted on the reverse, and the excess material is cut with scissors by a "trimmer." These vary in dimensions from 14 inches in diameter down to 2 inches. But of all the flags of the United States the President's flag entails the most labor. To make it requires all of one woman's time for a full month. This flag, consisting of a blue ground with the coat of arms of the United States in the center, is hand-sewed and it takes days of patient stitching to secure in place the life-sized eagle with its great wings outstretched. The flag is made in two sizes, 10 by 14 feet and 3 by 5 feet.

In point of color and emblems the foreign flags are a gorgeous aggregation. Many of them are made up of complicated designs and cost our Government a considerable sum both for material and the making. Some

(Concluded on page 531)

The machine that cuts out the stars for our National flag. Eight different sizes of stars can be cut with this machine

Clipping the patches to form stars on the reverse side of the flag. By this ingenious method the stars on both sides are made to register

Strategic Moves of the War—May 17th, 1917

By Our Military Expert

MARSHAL JOFFRE is said to have remarked that all previous experience in warfare can now be thrown into the scrap heap—and a more true saying could not be written if the accounts of the present fighting on the Western front are correct. When Hindenburg can throw forward part of his reserve, given at 160,000 men, to assault one portion only of the British fighting line and when the artillery can pound opposing trenches night and day, and for days, the magnitude of the present conflict raging in front of Arras on the north, and east and west of Rheims on the south, can be imagined, but not realized. Nothing in former wars is comparable to it. With floods of liquid fire, clouds of deadly poisonous gases, and streams of boiling oil thrown from their positions upon their adversaries the weapons of the dark ages of history have been adapted to modern warfare.

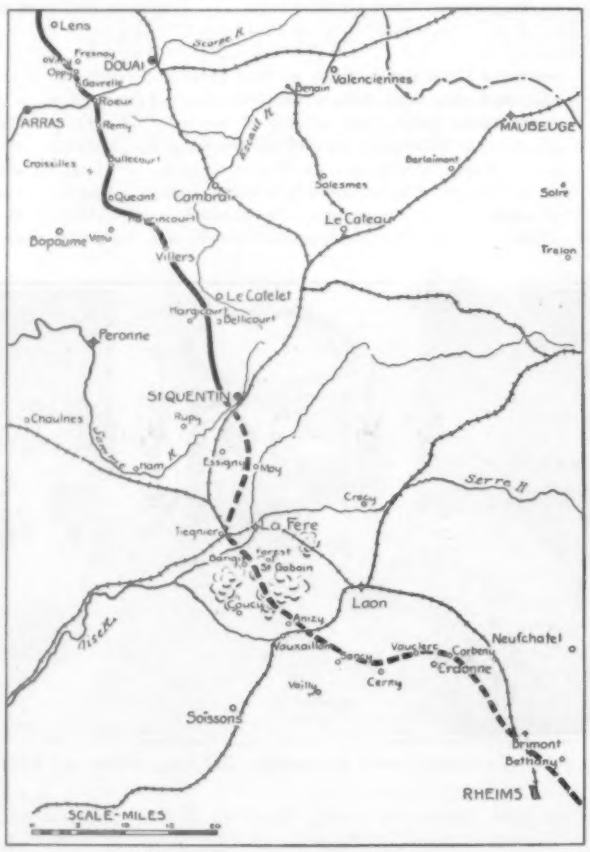
The great battle of Arras began April 9th and has continued practically unceasingly ever since. Since that time progress has been made for five and a half miles to the northeast to Fresnoy in the direction of Douai; for six miles due east to Chérisy and ten miles southeast to Bullecourt in the direction of Cambrai. It is slow progress, but it is an advance after all and a great advance when the terrific opposition of the German troops is considered. And more than half has been gained by the steady push after the first rush was over.

On April 9th when this first rush began on the north, the British ended close to Vimy; since that time they have steadily gone forward through Arleux-on-Gobelle to Fresnoy for a greater distance than the earlier gain. Fresnoy was taken by the British early in May but was retaken by the Germans later. Its original capture opened the way for an advance of the British in the Drocourt-Quéant line containing the only defensive works between them and the Douai-Cambrai defensive positions. The recapture of Fresnoy by the Germans and their hold on the town of Oppy held up the advance of the British in this part of the battle lines. The forward push of the British was then transferred once more to the valley of the Scarpe and the recent capture of Roeux after bloody struggles opens a way along that stream, for an advance on Douai; such a move will outflank the Oppy line and must hasten the capture or abandonment of Lens—which city would be then practically pocketed. However, a section of the Drocourt line is now held by them, east of Bullecourt running in the direction of Quéant. The Drocourt-Quéant line, representing as it does the work of thousands of prisoners and months of labor, is evidently a stout barrier especially strong under present conditions; the British are successfully hammering at it—it seems to be only a question of time when it too will find its fate. Early in May the Germans made heavy attacks on their right south of Bullecourt where the British have crossed the old Hindenburg line just above the point where it joins the emergency line established on Quéant. These attacks have been repulsed with enormous losses to the Germans and Bullecourt is now practically in the hands of the British.

In order to understand the wide battle front as a single engagement the physical objectives of the British and French movements must be considered, viz.: Douai and Laon, the two abutments on which the German commander has built his bridge for holding northern France. The fall of either city would destroy the bridge and force a retreat to the Franco-Belgian frontier. The moral objective of the commanders of the French and British armies is the destruction of the German armies; and, as they greatly outnumber their adversaries, the heavier fighting is to their advantage as they are wearing down both the German armies and their reserves. The British and French stand today at practically the same distance from their objectives; as stated above, Fresnoy is just eight miles from Douai and Courtecon on the Chemin-des-Dames is eight from Laon. The heavy fighting that has also taken place around Bullecourt has exceeded in intensity almost anything that has been known. For a time at least all idea of a forward movement of any extent or of the permanent capture of positions has passed away, as both sides are firmly grappling with all their might for a fight to a finish.

It is no longer a question of extent of ground that may be gained but of the number of men that can be put out of action. The greatest number of guns of various calibers ever brought into battle is firing unceasingly with a slaughter never before known; the infantry follows to put the finishing touches upon bloody scenes never equalled in the world before. While there is every prospect that the Allies will gain the upper hand at an early date, it will be well not to be too optimistic, for Hindenburg is reported to have been heavily reinforced by forty or more divisions from the Russian front. This battle now raging is a frightfully costly affair to both sides engaged and the end is not yet. Since the battle of Arras began the Allies have captured 50,000 prisoners, and have taken 450 guns; granting the unusual proportion of one prisoner to five killed and wounded, there would be 250,000 Germans placed *hors de combat* in a little more than one month. The Allied losses are probably not so high since the assaults that have been so costly in lives have been usually made by the Germans. Even then it is likely that the Allied losses in the same time will amount to 200,000 killed, wounded and prisoners—a frightful toll during so short a time.

On the Soissons-Rheims front, the Allied troops struck a particularly heavy blow when they captured the village of Craonne together with several fortified positions north and east of the village and also German first line trenches on a front of two and a half miles to the northwest of Rheims. The village of Craonne is about nine miles southeast of Laon and stands on a height at the eastern end of the Chemin-des-Dames, the road that runs parallel to and north of the Aisne along the plateau. This height commands and protects the plateau north of the Aisne and also the lower levels between this height and east to Neuchatel. Its capture



Theater of war, Lens to Rheims

British front in solid black, French front broken

gives the French an open road up the valley of the Miette towards Laon. An advance up this valley would outflank the whole German position of which Laon is the center. Craonne itself is the southeastern bastion of Laon, the southern hinge on which the Hindenburg line swings; the fall of the latter town would, according to military critics, force a retreat of the Germans to the Franco-Belgian frontier. The fall of Craonne permits an attack upon Laon from the rear; in fact, the latter town is now within the range of the long range French artillery, a fact that is significant to say the least. Craonne stands on a height that commands the gap of the Miette—a tributary of the Aisne—on one side just as Fort Brimont northwest of Rheims guards it on the other. It is from Fort Brimont, still in the hands of the Germans, that Rheims is being bombarded and the complete destruction of the famed cathedral is being carried out. When Fort Brimont is taken, nothing can keep the French from pushing up to the rear of Laon as mentioned above and the Germans will be forced to retreat from the Rheims salient.

On the west of the French front around Laffaux the Germans have concentrated their efforts for several days; however, not only have they been beaten off but the French have dashed forward and have gained new fortified positions. The counter attacks and strong resistance of the Germans here can be better understood when it is realized that, if the French gain Allemant and Pinon in the Aillette valley, they will have outflanked the whole line that runs north and northwest to St. Quentin. The famous Chemin-des-Dames or Road of of the Ladies running over the Craonne plateau is the key of this whole section; it is now for the greater part in the possession of the French. In several places, as at Courteçon, they have even gone beyond it. It was due to this road being in German hands that the latter were able to hold up so long the French advance. Its capture therefore shows the value of the successes of the recent battles along its length. The strong positions the Germans hold northeast of Rheims are already threatened by the continued French advance in the Champagne regions between the town of Beine and the village of Moronvillers. Recently the French stormed and took ten miles of trenches extending from a point northeast of Soissons all the way along the plateau to Craonne. By this advance they have reached the hills overlooking almost the entire valley of the Aillette River. Further to the southeast between Berry-au-Bac where the lines cross the Aisne and Loire to the northwest of Rheims the French made gains that are seriously menacing Fort Brimont. This together with an offensive northwest and east of Rheims carried the French over several heights and first line trenches. These victories may soon liberate Rheims as a target for the German heavy guns.

The Russians appear to have begun an offensive against the Germans in the Kovel district, heavy artillery fire having destroyed munition depots at points east of Kovel. Some slight actions are reported also on the Rumanian front. It must be confessed that the quiet along all these fronts has, however, an ominous significance. No one denies that the Russian soldier is one of the best fighters in the world and his reputation fully agrees with the old saying that it was "necessary first to kill the Russian soldier and then knock him down."

However, to the military mind the strictest discipline, consistent with justice, is always a *sine qua non* in an army. The recent decisions of the powers in control in Russia to permit the election of officers, the throwing off of all the distinctions between officers and men, and the other measures that have been proposed calculated to make a democracy of the army will introduce lines of weakness in the military organizations that will undoubtedly diminish the fighting power in a marked degree unless the class distinctions of centuries of oppression can still maintain order and discipline.

If Russia is in any position soon to strike hard along part or all her lines on the eastern front, the effect upon this year's campaign will be great, because the strong Allied advance on the Western front has drawn many German divisions from the east to help a desperate condition in France. But the present situation on the Russian front resembles the description given of it—an unofficial armistice. To what this has been due cannot at present be exactly determined. It may be the old question of arms, ammunition and guns, though Japan and the United States should by this time have sent enough to relieve any great stress. It may be a question of food supply; for, though Russia is a granary for some other parts of Europe, the lack of an extended system of railroads and the rundown condition of existing roads throughout this enormous empire may permit a feast in one part and a famine in another. It will be remembered that a scarcity of food—which may have been artificial—was one of the immediate causes of the revolution in Petrograd. At any rate, there is evidently something wrong, something that an outsider cannot fathom. At present it looks as though Russia were in a chrysallis state and would not emerge with her fully developed strength this year.

There have been some artillery and other actions on the Carso Plateau of the Italian front and heavy bombardments and some fighting in Macedonia; but in both cases, especially in Macedonia, the actions seem to have been brought on rather as a containing operation to hold the Central Allies and to prevent the sending of reinforcements to the Western front in France where they are so badly needed. Little of interest has occurred in Palestine or Mesopotamia, both sides apparently being occupied in consolidating their positions.

Summing up, it is an easy matter to take optimistic views of the Entente Allies' progress since the present great offensive on the Western front began. So far the French offensive is a strong threat rather than an advance; the British progress is a serious peril to Hindenburg's plans. If it were only possible for Russia to step in now with an offensive movement like that of Brusiloff last year, an end might be expected before the next autumn comes. If she can do nothing, it is possible that the Germans can stave off the inevitable for another year; but the end must come by the wearing down of the man power through killing, wounding and capturing the armies of the Central Allies.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Suggested Submarine Chaser Gun

To the Editor of the SCIENTIFIC AMERICAN:

This war has been the means of bringing many antiquated fighting machines into use again, and I think that one more will find a useful field if modernized and developed to its highest efficiency.

I refer to the old "revolving cannon" with five barrels firing fixed ammunition with a one-pound projectile. With slight alterations this gun, or rather a modernly built successor, would be just the thing for U-boat "chasers" and for the new 3,000-ton wooden freighters. It could be used either against U-boats or aircraft.

Would recommend that the old hand crank be replaced with an electric variable speed motor, similar to the electric self-starter as used on motors of autos and aircraft, and driven either from the ship's electric plant or preferably from an independent source, such as a storage battery, enabling the gunner to devote his entire attention to pointing his piece, and to controlling his fire, either firing each shot singly, or in duels with U-boats at long range, with slow deliberation, or in case of the U-boat being caught in the act of diving, he could riddle its upper works and periscope with a steady stream of shells or solid shot.

Against aircraft, the piece would afford the gunner the same opportunity of firing singly or "peppering" a rapidly moving machine with an avalanche of small shrapnel. In addition this type of gun would be much easier to load as shells are fed in from above from a "stick magazine" instead of from the breech which, judging from photos I have seen, is very inconvenient and difficult, particularly when the piece is elevated to its highest point. The "empties" could be led away from the piece through a flexible and telescopic metal tube of sufficient size to eliminate the possibility of clogging.

Therefore, this type of a gun would require but a small crew; perhaps only one man on duty at a time would be sufficient, as he would at all times have at his command the five barrels, in addition to the shells in the "stick magazine." The relief crew quartered nearby, by the time this supply would be exhausted, could supply the gunner with a second "stick" after hearing the first shot.

By having one of these guns mounted on an elevated position amidships of the new 3,000-ton freighter, it would give considerable protection, as owing to the lack of stacks, the gun could be fired in any direction, and owing to the comparatively small size of these ships, the range would probably be ample, as a U-boat or an aircraft would be compelled to come pretty close to do much damage.

Owing to the great number of this type of vessel it is proposed to build, as well as the great number of chasers, the man problem will be well worth considering, and to further conserve the supply, and to promote the efficiency of the man or men on constant duty at the guns of these craft, I would suggest that the guns be mounted on turntables, and that the same be revolved electrically, from motors placed beneath, and controlled by toe-buttons placed so that the gunner could operate them easily with the right or left foot, while the gunner sits in a comfortable position in his saddle, so that the entire turntable, with its gun and gunner, could be revolved. He would thus have a regular and almost continuous view of the entire horizon. If a second man was to be on watch with him, he could be seated in the opposite direction, so that the horizon would be searched twice each revolution.

While having served in the Navy, I do not claim to be an expert or an authority on such matters, so am offering these suggestions for what they are worth.

F. P. ARCHER.

Grinding Reflectors for Telescopes

To the Editor of the SCIENTIFIC AMERICAN:

If your correspondent who recently wanted information about grinding reflectors for telescopes, will send seventy-five cents to the Smithsonian Institution *by money order*, he can get Draper & Richey's great monograph on the subject; it is practically all that is known of that art. Our great American, Draper, the same who did so much for photography, was the originator of modern methods, which, as improved by Richey, leave nothing to be desired. The only limitation is the possibility of getting a monochromatic light source of sufficient intensity for testing large mirrors; but your correspondent will not be well advised to try those for some years yet. Reflectors can be ground by these methods true to a desired curve within one-millionth of an inch, and are customarily so ground to less than a quarter wave length of yellow (sodium D) light, or one 880,000th of an inch. Inch thick plate glass, costing about $1.50 per square foot, is just as good as optical glass for reflectors; though, of course, not for lenses. Its surface is ludicrously untrue for planes, but may be readily trued by the experimenter.

T. J. JOHNSTON.

New York.

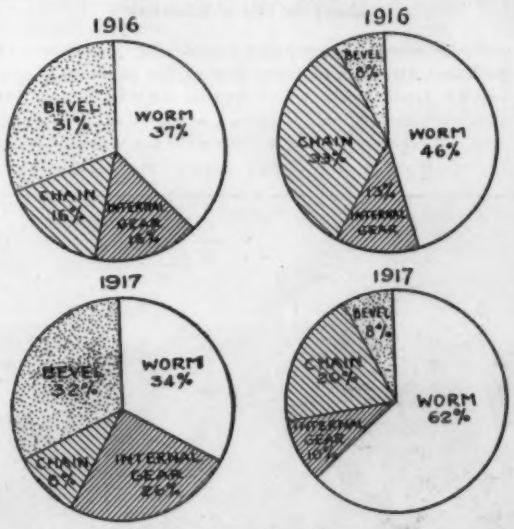
Muzzle Velocities

To the Editor of the SCIENTIFIC AMERICAN:

Answering various questions propounded by C. G. Young in your issue of March 31st, relative to my article on rifle muzzle velocities, the following is offered: The water will stay in the pot by gravity, the pot not being full and the mouth small to obviate chance of loss by splashing, which is slight: the bullets are not to penetrate the steel shell, though if they do so partly it makes no difference: deformation of bullet would appear as heat and would cause no error: stirring with the reading thermometer would cause a negligible error, certainly less than a thousandth of one per cent: heat loss by radiation could be compensated by the usual laboratory method of having the water cooler than the surrounding air before trial, as the approximate temperature after trial would be known; or a glass Dewar flask, silvered, could be made for the purpose to surround the device.

Relative to criticism of gravity method, the various errors introduced by peculiarities of an individual piece could be compensated by using average drop of several different rifles, an average of both different rifles and different bullets being necessary in any event or any device. As to there being an infinitesimal fall in one hundred yards, it depends of course, upon the velocity of the bullet. The army rifle bullet's velocity is 2,700 feet a second. It therefore takes it about one-ninth of a second to go 100 yards. Gravity will make it fall about two-tenths of a foot, or over two inches in this distance. Ordinary level rods, equipped with verniers, measure height to a thousandth of a foot. This would give three significant figures even in a hundred yards.

A. L. HODGES.



Motor Truck Drives for 1916 and 1917

Left, percentages of all cars manufactured; *Right*, percentages of makers, without regard to magnitude of production

A Matter of Motor Trucks

IN the review of motor truck trends for 1917 which appeared in our issue of Jan. 6th, last, we stated the percentages of trucks showing various features of design. It appears that we did not state with sufficient clearness that these figures were obtained by placing all makers upon a dead level, and making no attempt to weight each concern's decisions according to the number of cars turned out. Thus the statement that worm drive is found on 62 per cent of the year's trucks means that out of every 100 makers of trucks, 62 saw fit to use that drive.

Since the various makers naturally do not all have equal outputs, it does not follow that 62 out of every 100 individual trucks manufactured during the year will have worm drive. On this ground complaint has been lodged against our figures; and the claim is made that only by using the total number of trucks, rather than the total number of makers, can truly significant percentages be found.

There is something to be said both for and against this point of view, and in common fairness the SCIENTIFIC AMERICAN wishes to put forth both sides of the matter. In fact, the discrepancy between the figures for final drive which we presented in January and those which are arrived at on a basis of individual trucks is so great that it is quite necessary to say something to indicate why this should be.

Obviously enough, it seems a trifle unfair to the concern which makes 10,000 trucks each year to give its judgment upon points of design no more weight than is given that of a maker who is able to turn out but ten trucks. The argument may be very plausibly brought forward that the extent to which the trucks of a given maker are used is a fair measure of the value of his judgment. But on the other hand, to take an equally extreme case, it is plainly not reasonable to say that, because the X Y Z Co. makes 51 per cent of the year's trucks, the X Y Z truck represents *in toto* the trend of the industry for the year. Moreover, while it is obvious that between the maker of ten trucks and the maker of 10,000 there can be no comparison in the matter of competent judgment, it is not at all clear that the maker of 10,000 trucks possesses a judgment just twice as valuable as that of the maker of 5,000 trucks.

These reflections indicate that while we have compiled one set of figures, the contemporary who calls us to account has compiled another. Our set means just what we claim it to mean—that the percentage of motor-truck makers who adhere to certain features of design is as stated. His set gives just what he claims it to give—the percentage of new cars sold embodying these features. Both sets of figures are pertinent and valuable, but it must not be overlooked that they do not mean the same thing, and that therefore they do not necessarily agree.

That they come far from agreeing is plain from the diagrams herewith. It will be seen that while a clear majority of this year's makers is in favor of worm drive, barely a third of the users, weighting each according to his demands for new cars, is in accordance with this opinion. The discrepancy is in the same direction with chain gears, but the other way with bevel and internal gears; both of the latter features are more popular with users than with individual makers. For 1916 the discrepancies were in each case in the same direction as for 1917.

Even more notable is divergence of the trend from one year to the other as worked out on these different bases. The bevel drive is just holding its own, alike among makers and users. The worm, on the other hand, while it shows a 30 per cent gain among the makers, suffers a slight falling off in the eyes of the users. With the internal gear the reverse is true; while slightly fewer makers are installing it, not far from twice as many buyers are asking for it. The chain drive seems to be on the down-grade from both points of view. Among the makers, then, the trend is from the chain and the internal gear to the worm; among users, from the chain to the internal gear. In each case the types of drive not mentioned in this last statement are neither losing nor gaining, but just nicely holding their own.

The Current Supplement

A MOST important physical phenomenon which has a very wide bearing on many branches of science, and which is not yet fully understood, is the "Brownian Movement." A paper on the subject, with special reference to electrified particles in gases, and the charge of the electron, will be found in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2160, for May 26th. *Rattan of Commerce* describes the varieties, sources and some of the uses of an important tropical plant, and is illustrated by several engravings. *Waste in Coal Production* discusses conditions existing in England, many of which may also be found in this country. *Teaching Children to be Useful* speaks of the important work being done in the "Settlement Houses" that are found in many of our large cities, and it is illustrated by several photographs showing one of the methods adopted for amusing and instructing children and taking them off the streets. *Probable Immigration after the War* discusses a problem that will soon become of vital importance to America. *Steel and Steel Alloys* describes the relationship between steel and iron, and the different kinds of steel now in use. *An Electrical Boiler Water Level Recorder* describes and illustrates an interesting modern technical appliance. *Anomalies of the Animal World* is another of the interesting series of articles on natural history that are appearing in the SUPPLEMENT. It is accompanied by one illustration. *The Equipment of an Army* is a timely article that will be of wide interest. Other valuable articles include *Paper Films for Photographic Negatives*, *The Production of Fluorescent and Phosphorescent Effects*, *Zuni Chronology*, *First Aid to Wounded Trees* and *The Limitations of Standardized Shipbuilding*.

Archeological Survey

AN Archeological Survey of the American Virgin Islands has recently been made by Mr. Theodoor de Booy, of the Museum of the American Indian. The results of excavations at pre-Columbian village sites show that the Indian inhabitants of the Virgin group did not, as heretofore has been supposed, belong to the same race as the aboriginal inhabitants of Porto Rico. Among the paleontological remains discovered were those of a flightless bird previously unknown from this region.

Military Engineering

What Germany Has Learned From Russia About Trenches and Cover

By Albert K. Dawson

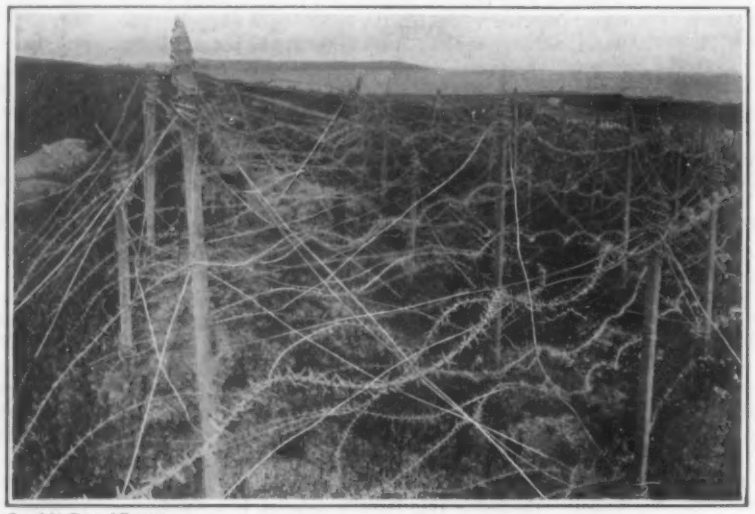
THE high efficiency of modern artillery fire, its long range and accuracy has brought about a complete change in the art of defensive warfare, especially in devising protection for troops exposed to such attacks.

When we consider the destructive force of a single high explosive shell and the number of shells which an enemy can now concentrate on a given point, we can easily see that the defender must either invent some means of protecting his men from this fire, or suffer unheard-of losses.

In solving this problem, the Germans have devised the underground trenches or, as they have been aptly called, the "catacombs of war." I do not think the idea originated with them, but came from the enemy to the north: for from my own observations in the beginning of the war, I found the defensive works of the Russians to be superior to those of the Germans, while those of the French and English were far inferior.

At the beginning of the war, the Germans had the preponderance of artillery and the Russians *must* seek cover or be wiped out. Then, too, the Russian brought with him the experience of the long, hard campaign against the Japanese. The first underground quarters I saw, other than a dugout in the side of a bank, were in Poland in the spring of 1915. Here in the outerworks around Ivangarod the Germans found underground positions which made their staff officers sit up with surprise and admiration. I visited several of these underground camps with an officer of engineers who was making maps and drawings. Many of the German staff came out to inspect them as well, and were loud in their praise of the work of the Russians.

Although the Russian works seemed complete in every detail, yet the Germans, after having once adopted the idea, carried it to a still further degree of perfection, as the accompanying sketches will show.



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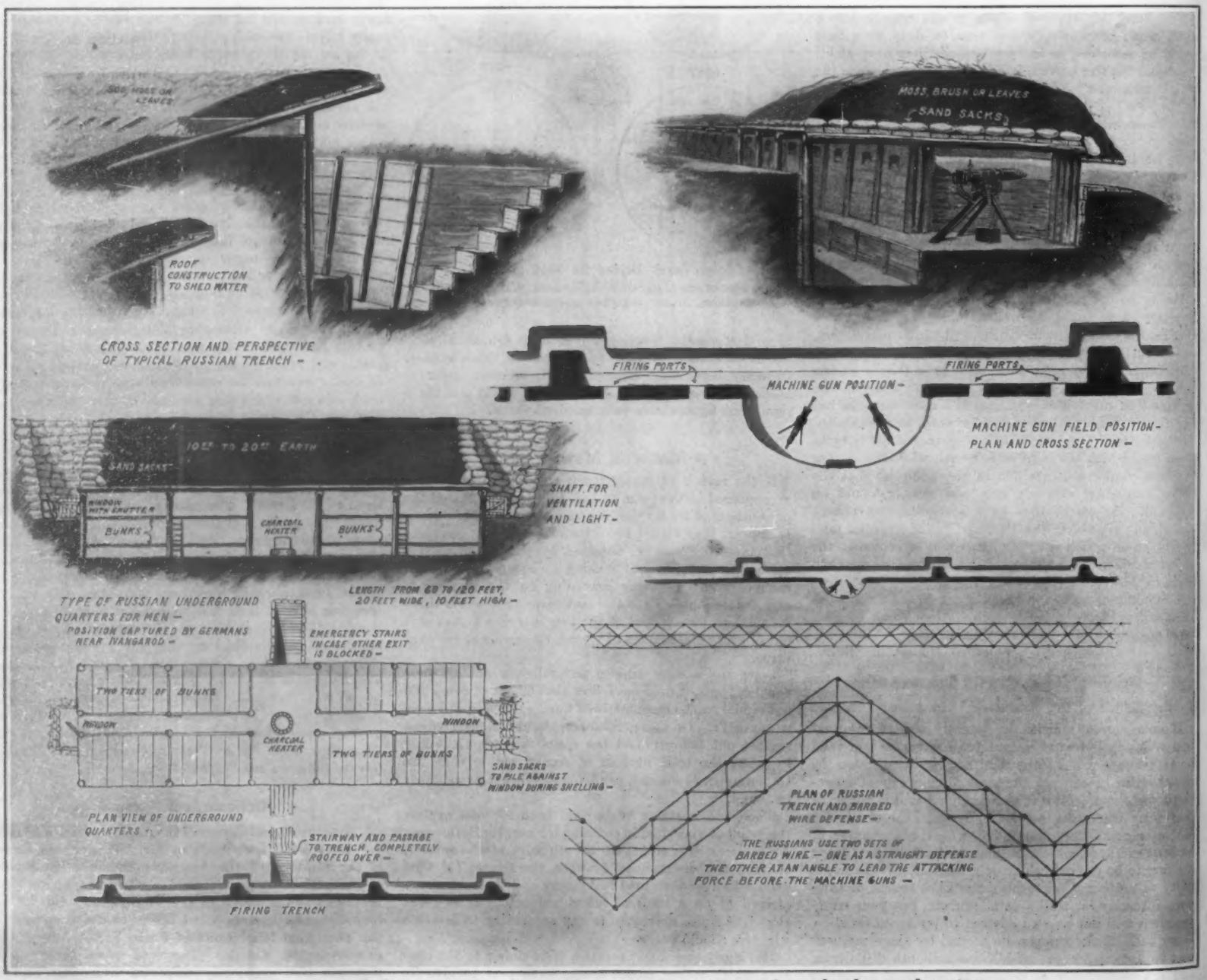
Section of barbed wire entanglements that formed a barrier about the city of Kiaochow

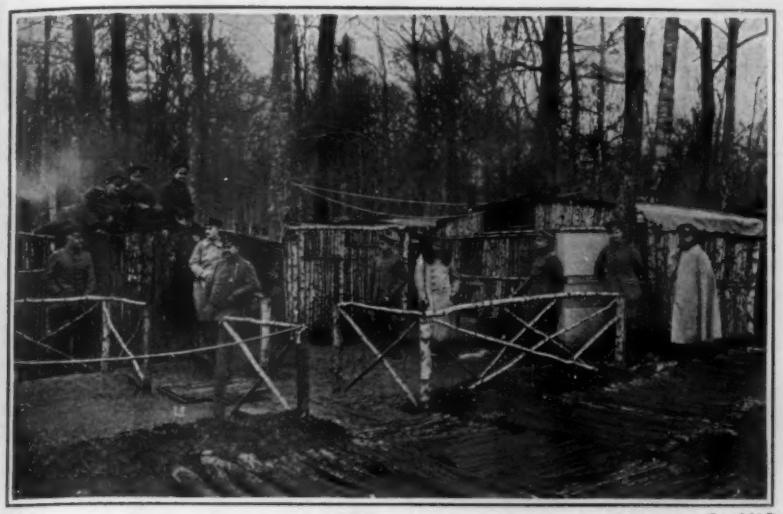
Field defense comes under two heads; first, works of sufficient strength to resist enemy fire or assault and, second, those works which depend on concealment for their defense. Usually we find a combination of these two. First, every effort is made with the means at hand to render a position proof against fire and, second, every effort is made to conceal it from the enemy observers, be they tree top or aeroplane, so that he will not know where to direct his fire. In this way a few green branches are often more protection than a thousand sand sacks.

In their retreat from Poland, the Russians fell back successively from one well-constructed line of field works to another. Without these field works, that retreat would have become a rout of the worst order. These lines of entrenchments stretched across the country for miles and miles. Every time the terrain offered an advantageous point of resistance, we found another line of field works and wire entanglements. Hundreds of miles of wire entanglements have I seen fall into the hands of the Germans, all of it of American manufacture.

The Russian trench nearly always had a protection overhead for the soldier. The Germans and Austrians did not have this then, but have since adopted it. This protection usually took the form shown in the accompanying sketch. This roof not only offers sure protection from shrapnel and bullets, but it gives a feeling of protection from heavier projectiles. The man has a feeling of security here which he does not have with the open top. The machine gun positions were always heavily protected and shored up with the strongest timber; for they are always the target for the enemy's artillery. In many of these I saw the long, dark firing aperture fitted with a burlap curtain painted green to match the embankment; for this long, dark slit is easily spotted by the enemy observers. The machine gun



Typical Russian barbed wire entanglements, machine gun emplacements, trenches and underground quarters



German officers' quarters concealed in the woods, in Northern France

Russian field fortifications in Galicia, captured by the Germans

positions either occupy a projecting corner of the line or extend out from the line, much like the flanking towers of a castle.

Beyond the trench we find the barbed wire entanglements, always one and sometimes two zones of wire. In case there are two bands of wire one is placed directly in front of the trench at an even distance of about ten yards and the other is much farther out in front and zigzags back and forth. The idea of the zigzag is to create lanes which will bunch the charging enemy and lead him into the angle just before the machine guns. An entanglement may consist of from three to twenty parallel rows of posts with the wire woven every which way among them. To these wires we often find a lot of empty tin cans tied, each can containing a stone. These serve as alarms. Should any one start to cut a way through in the night, the rattle of the cans would soon give him away. No invention of man has proven such a perfect defense as the humble barbed wire, originally intended for no more warlike purpose than keeping cows in a pasture. Moats, abattis, wolf hole and other forms of defense have given way to it. I have seen entanglements where I know men had charged through, and I shudder to think of the punishment they received, and I have peeped through the loopholes to where grim forms hung contorted in the entanglement where the last charge broke as a wave breaks on the shore.

At favored points behind the well-constructed Russian trenches we found the underground barracks. These were large enough to shelter from 200 to 400 men, packed in rather tight it is true, and strong enough to protect the occupants from fire from all but the very heaviest shells. On the roof we found from ten to twenty feet of earth with the sod put back in place to hide their location from spying aeroplanes. Usually, these barracks were built in pairs with a connecting tunnel, each with an exit to the covered trenches and an emergency exit. Inside we found a corridor with a double row of sleeping platforms on each side and in the middle a brazier for a charcoal fire. A ventilating shaft is found at each end equipped with heavy shutter, and sand sacks for protection. In some were covered latrines branching off from the connecting tunnel. None of these underground barracks appeared to be permanent dwelling places, but emergency cellars in case of shell fire. The material used is heavy logs for overhead timbering, sawed lumber for shoring up and loose earth for cover. Sand sacks are used to build up around the openings. The old type fortifications of reinforced concrete and masonry has been found to be worth very little in modern warfare. First, they must be prepared long in advance, so that their location becomes known to the enemy, and second, it seems the more solid and compact the material used the greater the havoc wrought by the high explosive shells. Loose earth has been found to give the best shelter.

The Germans were quick to adopt this underground camp idea and a few months later on the West front, I found them already turning the abandoned mines, chalk caves and quarries of that section to their use. These caves make fine shelters for the men, being absolutely secure from bombardment, dry and of an even agreeable temperature. I visited one cave sheltering then 3,000 men. They had a blower fan ventilating system, operated by hand and were then installing electric lights. They were also cutting two extra exits to the outside world to prevent their being entombed by a well directed shot from the enemy. This is the largest single unit I found underground. The usual underground village holds fewer men.

The Germans may have intended their field works in the West to serve as the boundaries for their new Empire, judging from their permanence. This theory is given color by a book, "Mittel Europa" by Friederich Nauman recently published in Germany. In this he says, "The future Europe will contain a system of Chinese or Roman walls made of barbed wire and earth, and stretching from the lower Rhine to the Alps, and from the Baltic to the Black Sea." According to this author these huge trench frontiers, built in the most impregnable style and constantly ready for soldiers, will split Europe into three parts. With this idea in mind we can see why the Germans have toiled so mightily.

British destroyer "Broke"

Length, 320 feet. *Beam*, 32½ feet. *Draft*, 11 feet. *Displacement*, 1,500 tons. *Speed*, 32 knots. *Armament*, six 4-inch guns.

British destroyer "Swift"

Length, 345 feet. *Beam*, 34 feet. *Draft*, 10¼ feet. *Displacement*, 1,800 tons. *Speed*, 35¼ knots. *Armament*, four 4-inch guns.

THE BOATS WHICH DEFEATED SIX GERMAN DESTROYERS IN THE ENGLISH CHANNEL

Old-Time Sea Fight in the English Channel

THE colored cover of this issue calls to mind an incident in a fight which occurred between British and German destroyers in the English Channel which reminds us vividly of the battles of a hundred years ago in the days of Nelson and Paul Jones and the era of the sailing craft and the smoothbore.

We had come to think that the long-range gun and speeds of twenty to thirty-five knots had banished forever the old "boarding party" and the slashing hand-to-hand attack with cutlass and bayonet—as indeed it has; but the recent action in the dark of an April night between two groups of destroyers in the English Channel, was fought at such close quarters that ramming was resorted to, and, in one case, a boarding party actually attempted to take possession of the fo'c'stle deck of an enemy ship.

It all happened in this way: two destroyers that were patrolling the English Channel off Dover, on the night of April 20th, suddenly came upon a flotilla of six German destroyers, and in the fierce fight which followed, four of the German boats were torpedoed or rammed and the others driven off; while the two English boats, in spite of their being so heavily outnumbered, came back into port, badly battered it is true, but still serviceable.

The "Swift" and the "Broke" are two of the largest destroyers in the English navy. The "Swift," launched in 1907, is in a class by herself; and when she was built was about twice the size, and very much faster, than any existing destroyer. She is 345 feet in length, 34 feet in beam and draws 10½ feet. Her displacement is 1,800 tons, and on her trial she reached 36 knots, although her official speed is given as 35.25 knots. She has the large complement, for a destroyer, of 150 men. Her armor consists of four 4-inch guns, which is the armament carried by the latest of our own destroyers. The "Swift" was a purely experimental type and never repeated in the English navy; but, subsequently a class of vessels of nearly the same size, was built for the Chilean navy and purchased in August, 1914, on the outbreak of war. One of these, renamed the "Broke," after the British captain who was in command of the "Shannon" in the celebrated "Chesapeake"-"Shannon" conflict during the War of 1812, was the companion patrol boat to the "Swift" and shared with her the honors of the sea fight.

The "Broke" is also a large vessel for her class. She is 320 feet by 32½ feet and draws 11 feet. Her normal displacement is about 1,500 tons. She is heavily armed with a battery of six 4-inch guns, and her speed is 32 knots.

The official report of the engagement states that the "Swift," while engaged with the "Broke", on night patrol in the English Channel, off Dover, sighted the enemy at 600 yards, and the Germans at once opened fire. The "Swift" replied, and tried to ram the German destroyer at the head of the line. She missed ramming, but shot through the German line, and turning, torpedoed one of the enemy. She again dashed at the leader, which eluded

(Concluded on page 531)

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

An Emergency Means for Bringing Damaged Submarines to the Surface

UTILIZING a number of ballast tanks which can be more or less filled with sea water by means of valves and pumps, according to the degree of buoyancy desired, a successful submarine depends primarily upon the efficient operation of these ballast tanks and pumping mechanism; for once these are damaged or rendered inoperative, the submarine can no longer be maneuvred in the vertical plane. In other words, and more to the point, the underwater craft with a damaged ballast mechanism often submerges and remains so, since the crew is unable to restore the buoyancy necessary to bring it back to the surface.

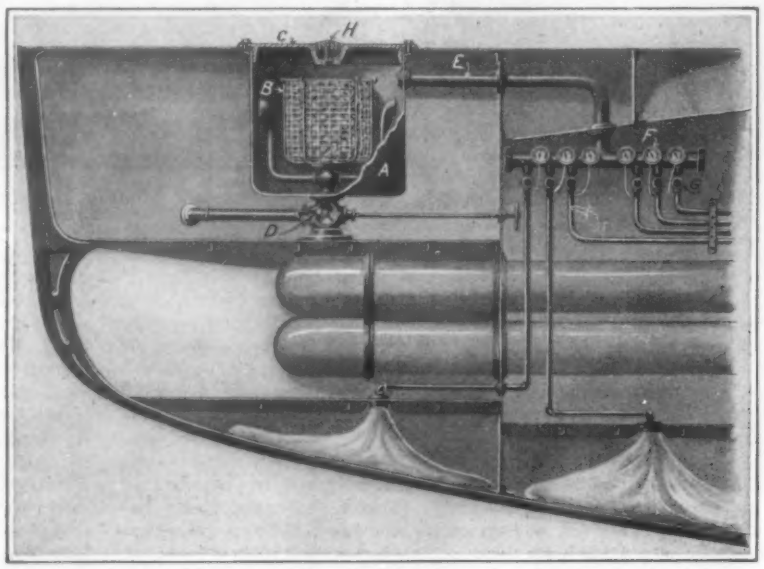
By the application of a simple principle Anthony Musorofiti of Brooklyn, N. Y., has invented a means for bringing a damaged submarine to the surface after the usual methods have failed. His invention can be installed in any submarine without extensive alterations, and when once installed can be operated by the crew in emergencies.

Referring to the accompanying drawing of the complete submarine, it will be noted that Mr. Musorofiti proposes using a number of waterproof bags in the usual ballast chambers of the submarine. Normally, these canvas or rubberized-fabric bags are collapsed, and the tanks are filled and emptied in the usual manner, without interference from the bags which occupy little space. In the event of accident, however, such as damaged pumping equipment or perforated ballast tanks, the bags are filled with a readily-generated gas, thus driving the water out of the tanks and restoring the buoyancy necessary to bring the craft back to the surface.

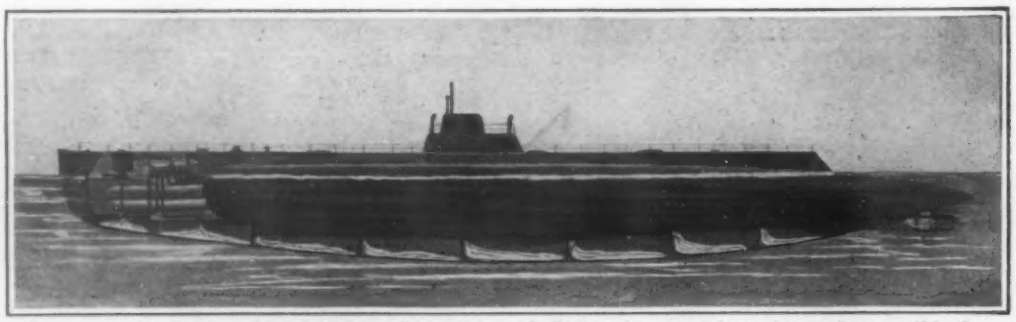
How the inventor proposes filling the bags with gas is shown in the other view, which represents a tentative arrangement for the gas-producing and distributing apparatus. The gas generator, *A*, may be made in any form best suited to the gas-producing chemicals used; in this case it is intended for calcium carbide, which generates acetylene gas when brought in contact with water. The carbide is placed in the wire basket, *B*, after which the generator lid, *C*, is secured in place. To produce the gas the valve *D* is manipulated, permitting sea water to flow into the generator and come in contact with the carbide. The acetylene gas produced is distributed, after passing through the main pipe *E*, through the individual valves *G* and pipes to the individual gas bags. Each pipe, it will be noted, is provided with a gage which serves to detect leakage arising from a damaged or imperfect bag. So it is that if a gage indicates a pressure considerably lower than the other gages, the operator knows that the bag with which it is connected is ruptured or otherwise damaged, and that gas is escaping; and in most such instances it is advisable to shut off the supply of gas by means of the individual valve, since no purpose can be gained and much gas can be lost in maintaining the supply of gas to the defective unit.

As the bags become inflated with the gas they naturally displace the water in the ballast tanks, with or without the aid of the pumping mechanism, as the case may be. Alone, the gas pressure is sufficient to drive out the water and create a buoyancy sufficient to bring the craft back to the surface from a considerable depth. As a protection against excessive gas pressures the inventor has provided a sort of safety valve, *H*, fitted to the gas generator.

While the invention has not as yet been tried out in actual practice, Mr. Musorofiti has given it a thorough test on a small scale, using model submarines for his purpose. One model, weighing well over 200 pounds, can be submerged to a depth of three feet or more, after its ballast tanks have been rendered useless by being perforated with several hundred holes so that water readily finds its way into them. Using about one-half ounce of calcium carbide, this model submarine comes to the surface in fifteen to twenty seconds after the valve has been opened and water introduced into the gas generator, and when once on the surface the craft remains afloat indefinitely because of the gas-filled ballast tanks.



Gas-generating apparatus and distribution system employed in conjunction with the gas bags for restoring buoyancy to a damaged submarine



By means of a number of gas bags placed in the usual ballast tanks, a new invention makes possible the restoration of buoyancy even after the submarine has been seriously damaged

Obviously, the arrangement of the gas-generating and distributing apparatus can be modified to meet actual conditions. The inventor suggests, for instance, that the carbide could be put up in the form of rods or cartridges, and kept in a sort of magazine until required. These compact packages or cartridges could then be introduced into the generator through a breech mechanism, and as many as required could be used to generate the desired volume of gas. It is further suggested that the principle is not necessarily limited to submarines, and that it can be applied in a similar manner to collapsible pontoons to be carried by aeroplanes and filled with gas in the event of a forced descent over water. In fact, Mr. Musorofiti's invention covers a general means for floating or raising fluid-supported objects.

Protecting Electro-Plating

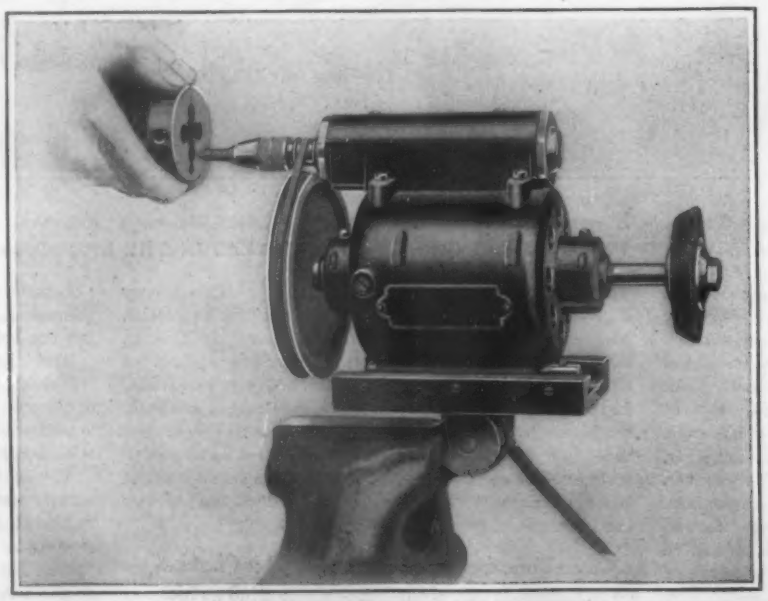
THE superiority of zinc over other metals as an anti-rust coating for iron and steel is commonly accounted to be due to the fact that zinc is electro-positive to iron. With the exception of cadmium, all other metals which can be used for commercial electro-plating are electro-negative to iron. But the superiority of zinc might be due in some part to its being less porous than the other plating metals; and to determine this point a series of experiments has recently been carried out at the University of Wisconsin. The most striking feature brought out was the complete protection afforded against rust, during four months of very wet weather, by electro-galvanization less than .0002 inch thick, while rusting occurred through deposits of copper .0027 inch, of brass, .0033 inch, and of nickel .001 inch. With thin plating rusting was serious and widely distributed, but on thicker deposits it was confined to a few widely scattered spots. It was finally concluded that the remarkable protection afforded by very thin deposits of zinc must be due to absence of voltaic action, since the thin zinc coatings proved to be as porous and as full of pits as were coatings of other metals. The experiments covered a wide range.

A Grinder That Revolves at Fifty Thousand Revolutions per Minute

OWING to the big advance in the prices of tools and the difficulty of obtaining them, the past year has witnessed a goodly portion of the inventor fraternity busily engaged in designing machines that tend to lengthen the life of tools. Many of these new ideas have found shape in practical machines which have had an important bearing on the metal-working industry.

It is particularly in the obtaining of standard button dies that the tool shortage has been most acute, and as a consequence those using large numbers of these tools have been forced to seek means for conserving their present stock of dies. Happily, an electric motor manufacturer, prompted by numerous inquiries for some special tool for regrinding button dies, has come to the rescue with a special attachment for his regular grinder, which makes it possible to obtain a spindle speed of 50,000 revolutions per minute.

The grinder, capable of developing the unusual speed of 50,000 revolutions per minute, is illustrated in the accompanying illustration. It will be noted that a round carborundum pencil, 3/16-inch diameter, is held in a special chuck. These pencils may be dressed down to various sizes so that they will enter and grind the four holes in the usual button die. Because of the high speed of this grinder, it has been necessary to balance dynamically the various parts and to equip the spindle with ball bearings, in order to ensure successful operation. The manufacturer claims that a die reground with this grinder cuts a better and cleaner thread than a new die; furthermore, it can also be used for lapping out small holes in blanking dies, punches and other tools.



At a time when there is an acute shortage of button dies, this 50,000-r. p. m. grinder is invaluable in the machine shop

A New Method for Testing the Workability of Metal Sheets

IN testing the quality of metal sheets the only method used heretofore was the "tensile strength" test. The machine used for this purpose did not give reliable results with thin sheets, however, and in the practical application of metal sheets it is not so much the tensile strength but the drawing, stamping, compressive and folding qualities which determine whether the material is best suited for manufacturing purposes.

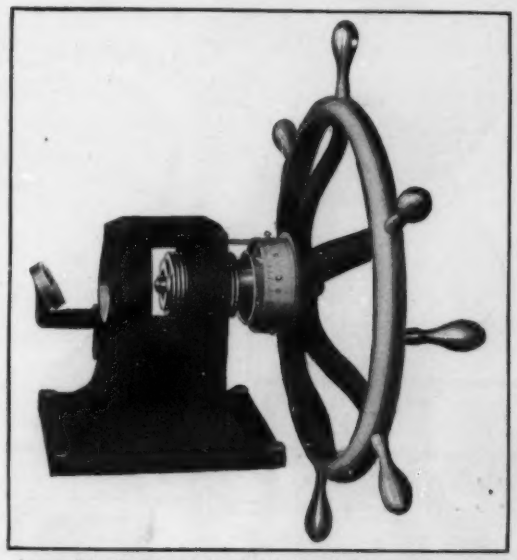
Bearing the foregoing facts in mind, A. M. Erichsen, a Norwegian metallurgical engineer, has recently devised a method for testing metal sheets, on which patents have been granted in the United States and in all other leading countries. This method determines in a simple and rapid manner the actual "workability" of metal sheets to the point of fracture. A specimen of the sheet or strip to be tested is clamped between two dies and held in such a way that the metal has "play" and can "flow," while a tool having a rounded end (perfect semi-ball) is moved gradually forward under the influence of a ram, actuated by a micrometer screw, until fracture occurs. The test piece is under permanent observation of the operator, so that the point of fracture can be determined with great accuracy. The depth of impression required to obtain fracture can be read off directly with a micrometer scale, and represents the "Erichsen value" of the sheet, which is a new basis for the workability of all metal sheets for manufacturing purposes.

How the new testing machine operates may readily be noted in the accompanying sectional view. The first operation is to measure the thickness of the sheet to be tested, and this is accomplished as follows: The scale *D* is set to zero by shifting the movable collar on which it is engraved until the spring *F* snaps into a small hole provided in this collar. The sheet specimen is then inserted in front of the die *B*, and the handwheel *G* turned until the sheet is firmly clamped between the die and the holder *C*, whereupon the thickness can be read on the scale *D*, which is divided into one-hundredths of a millimeter. The total range of this scale is five millimeters, and readings can be continued on the scale *H*.

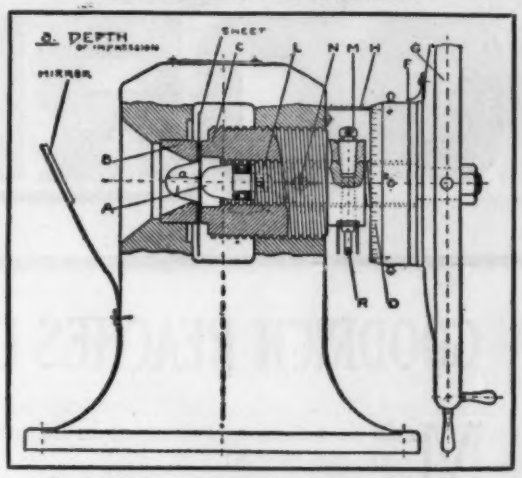
After the thickness of the sheet has been measured and noted, the handwheel is turned back five small divisions on the scale *D* (5-100 millimeter), in order to give the test piece a certain amount of play, which is the same for all gages of sheet. To secure the holder *C* in this position, the wing screw *N* at the right side of the machine may be tightened. The scale collar *D* must now be shifted until the zero point of the micrometer scale meets the zero point on the scale *H*. Then the gear is shifted by pressing against the milled ring *R* and turning the handwheel to the right (in clockwise direction). The tool *A* now moves forward into the sheet, by means of the screw-movement *L*, and the bulging is immediately noticed in the mirror at the end.

The operator continues to turn the handwheel, all the while watching the image in the mirror until the moment of fracture is reached, when the depth of impression has to be read off on scales *H* (in millimeters) and *D* (in hundredths of a millimeter). In approaching the point of fracture the wheel should be turned slowly, so that readings may be accurate to 1-100 millimeter. After the depth of impression has been read, and noted, the screw *N* is loosened and the handwheel is turned quickly to the left until the gear shifter automatically snaps back to the outer gear, and the machine is ready for another test.

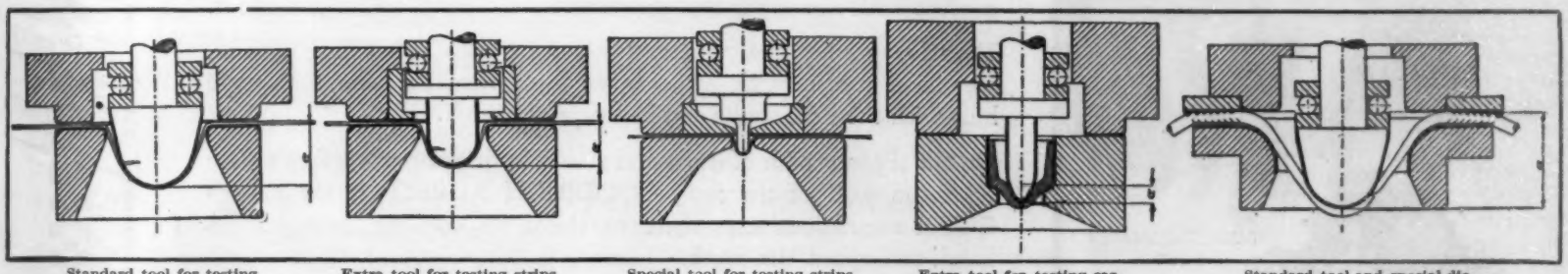
By using a special die and holder, the Erichsen machine can also be advantageously applied to tests of wires from one to six millimeters diameter. The machine tests the wires for tenacity and also for bending, as required for binding, telegraph, spring and aeroplane wires. To determine the hardness of cartridge cups, too, the machine is available when provided with special tools. Pieces of metal tube can be tested by being cut open and carefully straightened out with a mallet, after which they are tested in the same manner as sheet metal. Erichsen values enable sheets and strips purchased on the specification of "spring hardness" to be tested. Since the depth of the Erichsen impression varies, on material of identical composition, in a certain proportion with the Brinell hardness of the sheets, the Erichsen machine may also be looked upon as a valuable apparatus for determining the degree of hardness of iron and steel and strips. The Erichsen machine thus offers means to the manufacturing plants to establish their own standards also for the hardness of metal sheets and strips, which cannot be determined accurately by the usual methods of hardness determination. Finally, aside fron the various measurements possible with the new machines, this method of testing permits ready observation of the marco-structure of the drawn metal on the "dome" produced by the indentation, thus often giving valuable information about the treatment which the material has undergone.



A novel testing machine for determining the drawing, stamping, compressive and folding qualities—the "workability"—of metal sheets



Sectional view of the testing machine, showing a sample of metal sheet just after the test



How the new metal-testing machine does its work: Tools and dies employed for various tests, and their action on the samples under test

The Electric Ice-Man

DRY refrigeration in the home is an idea just now worked out. It is attained by means of a small electrical device that draws its current from the light fixture and can be attached to any ice-box in a few minutes by cutting in the top of the box a 14-inch square into which it fits. When the current is turned on the box at once begins to be cooled, and in a very short time the food chambers below are at a temperature which keeps their contents fresh and pure. A thermostat regulates the operation, so that when the box has been brought to a proper temperature the current is turned off, to return automatically when the temperature has risen above a certain figure. Not only does this device do away with the bother of ice, but it eliminates the unsanitary features of the ordinary ice-box, in which the drain pipes become slimy even with the best of care.

The new method of refrigeration differs from the commercial manufacture of ice in that the tinned copper coils contain sulfur instead of ammonia. The principle is the same, manipulation of pressure being employed to make the sulfur boil by stealing heat from the box and then liquefy again by radiation into the atmosphere of the room. The liquid coming out of the bottom of the condenser is fed back automatically into the tinned coil inside the refrigerator by means of an expansion valve, stepping down these condenser pressures to the atmospheric pressure under which sulfur boils into a gas or steam at 14 degrees Fahrenheit.

Moisture abstracted from the refrigerator is deposited on the coil, and freezes because of this low temperature. The machine operates intermittently, so this frost does not accumulate. On the standstill period the frost will melt and run off through the drain pipe. The extent of this drainage is small compared to that of melting ice, and it produces no slime because, unlike ice, this frost contains no vegetable matter.

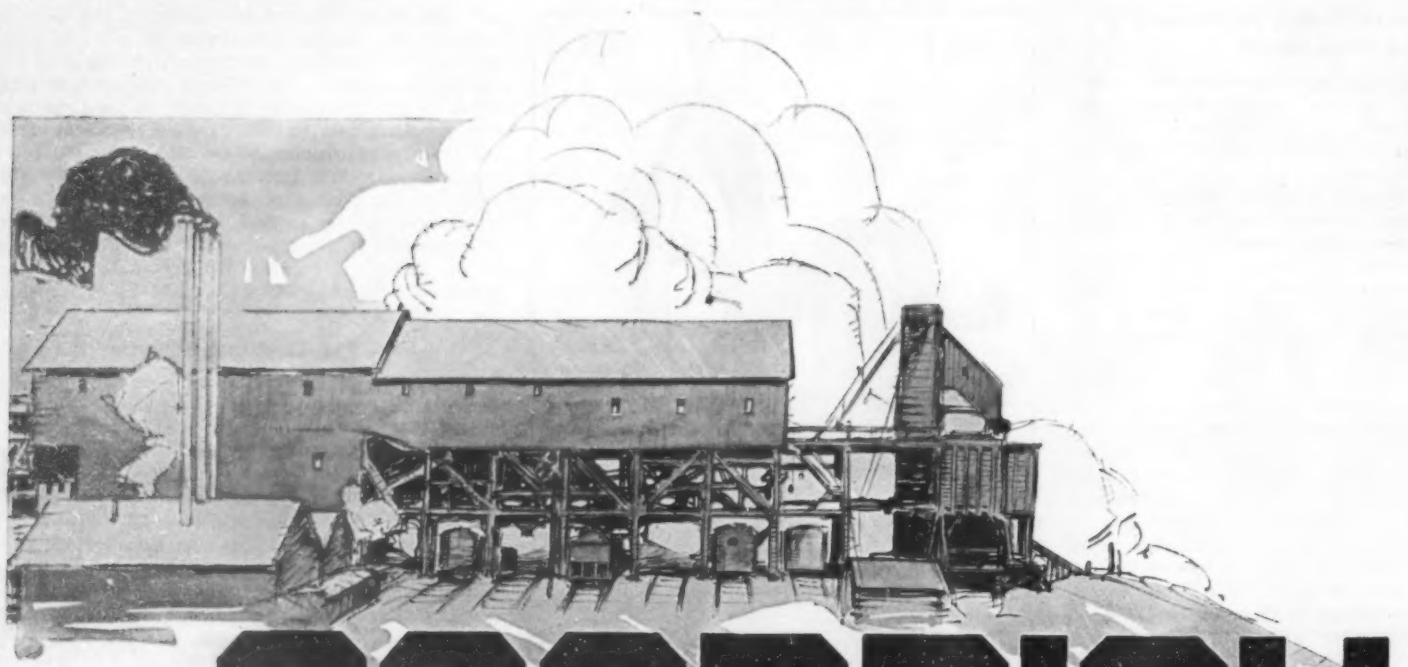
In the ice-making compartment it is possible to make 32 cubes of ice in a day of 24 hours, in warm weather. Ice can be made in winter only when the refrigerator is set in a warm room, since otherwise the machine will run for too short intervals. This process of ice-making, is of course quite automatic, aside from the necessity of leaving water in the compartment.

The current consumption varies with the temperature of the room and with the insulating qualities of the ice-box; but a fair average is one kilowatt or less per day. The temperature, by virtue of the thermostat governor, remains practically the same at all times; and on account of the dryness, food can be kept for a remarkably long time. One family last summer left a supply of meat and other edibles in the box to be ready for a hurry-up dinner upon their return from a week's outing; and upon arriving home they found everything in the best of condition.

The electric ice box in operation

Measuring Embryonic Activity of Chicks

APPARATUS devised at the West Virginia Agricultural Experiment Station for studying the vigor of germ in hens' eggs, consists of an electrically-heated incubator in which each egg is placed in a glass tube. Through this tube air is drawn, and the quantity of carbon dioxide given off by the egg is accurately measured. These measurements are made at frequent intervals, and a dozen eggs are under investigation simultaneously. The amount of carbon dioxide given off is taken as a measure of the growth activities of the embryo. The subsequent growth of the chicks, after hatching, is also studied, and compared with the activity of the respective embryos.



GOODRICH

GOODRICH REACHES UNDERGROUND

MAN is a *persistent* creature in his pursuit of what he is pleased to call WEALTH.

He goes for it to the uttermost ends of the world; and not content with *ransacking* the four corners of the earth, he *burrows* into it.

Yet wherever he goes, whatever his quest, GOODRICH RUBBER goes hand in hand with him, *not the least* when he honeycombs the hills with the dark vaults and hallways of his MINES.

On the slippery path of *winze* and *tunnel*, in dripping stope, face to face with the wall of the *drift*, GOODRICH RUBBER is the miner's faithful comrade, always there to shield his comfort, empower his hand, and speed the work.

HALF a century ago mining was a pick and shovel and hand drill affair. The miner went down the shaft to scratch loose a few bits of high grade ore, or a few barrowfuls of coal.

Today on account of the co-operation of Goodrich rubber, the miner brings forth *coal—ore—diamonds* by tons and hundreds of tons.

Shielded by a Goodrich *rubber coat* or *poncho* he goes to his post. *Hipress Boots* keep him dry shod as he stands in the muck and water. From Alaska to Patagonia, from Siberia to Cape Horn, that high pressure cure boot with which Goodrich upset the old order of the boot and shoe business, is the worker's idea of footwear.

With the miner on the job, Goodrich rubber is *behind* him, *beside* him, *everywhere*. Goodrich Air hose brings compressed air with which he drives his drill into hard rock at ten times the speed of a team of skilled "double jackers."

The blast shoots, tumbling tons of ore, and *Goodrich Elevator Belts* tram it to the top with a rapidity that relegates the ore bucket to the class of primitive methods.

FAIR LIST PRICES

GOODRICH

SAFETY TREAD TIRES

OIL WELL BELTS

INNER TUBES

WATER HOSE

RUBBER MATTING

RUBBER COATS

INSULATED CABLE

TEXTAN SOLES

AND Goodrich actually keeps the wheels of the mine running; for WITHOUT the Goodrich *Oil-resisting* hose—a remarkable rubber product of the Goodrich laboratories which withstands the chemical action of oil—mining machinery would soon whirl itself to rack and ruin.

A *like* story of *vital dependence* on Goodrich rubber runs through the gas and petroleum fields.

Two Goodrich innovations alone—the Goodrich Standard Concentric Mining Machine Cable, originated by Goodrich in 1914 and Goodrich pipe line coupling, produced by the Goodrich laboratories in 1915—would have written Goodrich in *red letters* for oil well operators.

Goodrich's Concentric Cable with its rubber stock covering retired the ordinary braided cable covering to the limbo of things outgrown; and Goodrich pipe-line coupling averted a *crisis* in the transmission of natural gas.

It had been found that gas passing under high pressure through a pipe line, deposited at every sharp turn a gasoline condensate which soon rotted the pipe. Leaks were common and losses enormous.

AT the height of the trouble, the Goodrich laboratories came to the rescue with a rubber coupling that *defies* the *corrosion* of this gasoline condensate, and today Goodrich coupling permits a pipe line of eccentric curves around obstacles which a few years ago would have spelled "impossible."

The manufacturing institution that always adapts its product to *meet pressing* industrial needs is the ONE institution in its field EVERY SEPARATE INDUSTRY recognizes and respects as THE LEADER. Its TRADEMARK is a guiding star to ALL who produce.

Because Goodrich turned its *experience*, *knowledge*, and *skill* in rubber making to help solve the problems of mining—just as its Silvertown Cord and Black Safety Treads ever forward the advance of the automobile industry with the last word in *tires*—GOODRICH IS RUBBER to the UNDERGROUND WORLD.

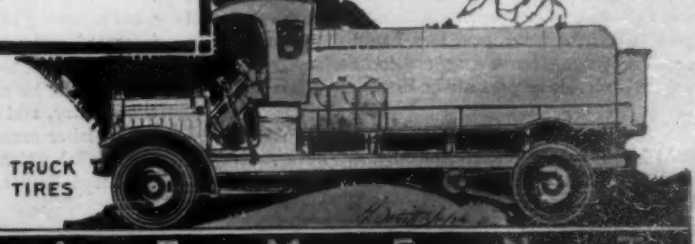
THE B. F. GOODRICH RUBBER COMPANY
AKRON, OHIO

PIPE LINE RUBBER COUPLING

OIL RESISTING HOSE

OIL SUCTION HOSE

TRADE MARK



TRUCK TIRES

FAIR TREATMENT

What I Can Do for My Country

IV. The Mechanic and Skilled Workman

IT has been suggested that, with definite assurance that we are to raise the bulk of our contribution to the military operations in Europe by means of a selective conscription, the present series ceases to be timely; that if the Government is going to restrict military service to those who can be profitably taken for that purpose, there is no necessity for the SCIENTIFIC AMERICAN to urge those who can not be spared not to go.

This is true only to a limited extent. It is always advisable that the man who is affected by a certain decision understand the reason behind that decision. He must be brought to see that it is not wholly arbitrary, not made for his special and personal discomfort. Only so can he be expected to do, with proper spirit and maximum effect, what it is decreed that he do. Therefore, even if complete control of all enlistment were put in the hands of some agency of selective conscription, it would still be well to point out, to those denied the proud privilege of actual membership in our armed forces, why they should be thus deprived.

But the volunteer system is far from abolished, even now. The man who seeks to serve his country by wearing a uniform and doing the actual fighting may still, if he can pass the physical test, join the navy, the marines, the regular army, the militia of his state. There is, indeed, a great hue and cry to secure enlistments in these bodies. This, of course, is appropriate; but such enlistments must not be secured at the expense of equally important branches of service. So, despite the fact that volunteers are not to be called for by the millions, it is no less important now than it was two months ago that the man whose best opportunity for service lies in the industries be brought to see that fact.

The Industrial Veteran

It is especially necessary that the man over thirty years of age "stop, look and listen" before embarking upon field service. Now that the age for conscription has been definitely established, we may look for more or less of a rush to offer their services by men above the limit—patriotic men, who were level-headed enough to wait and see whether they would not be called, but who are not sufficiently calm now that it is certain they will not. A rush such as this would upset the whole theory of conscription under an age restriction.

The supposition that between the ages of twenty-one and thirty a man is at his best for fighting purposes is but one reason for confining the draft to those ages. It is equally true that in that period of his life a man's present worth in his chosen occupation has not usually attained a maximum, and that the field in which he is employed can therefore, spare him, temporarily, better than it can a man ten years older. For future usefulness, of course, the young man far outweighs his senior; and we tremble to think of the state in which European science, technology and industry, will find themselves around the nineteen-thirties, when the generation now being so ruthlessly fed to the cannon should be just reaching the climax of its development. But when we are at war the future must invariably give way to the present; for if the present fail, the whole future ceases to exist. And for the hard, uncompromising present needs of the war, we must sacrifice the young men and keep the industrial veterans from sacrificing themselves.

In practically every industry the man of thirty-five is a superior workman to the one of twenty-five. He knows more about his work, he is steadier if not so brilliant; above all he has that intangible something which we call experience, and which, in the factory as well as on the baseball field, distinguishes the veteran from the strong-minded youngster who has but just "made good" and who sees the world as his apple. The experienced man, be he short-stop or lathe-worker, makes snap judgments only when he must, and then with reasonable probability that he is correct. The youngster, from sheer overflowing spirits, makes snap judgments habitually, on every occasion, and is as likely wrong as right. The veteran thinks of all contributing factors, the young man only of the one that occurs to him first. On the ball field the physical demands are so extreme that the veteran cannot long continue to meet them, so his career as a veteran is brief; in the industries this is not the case. Once having attained a state of mental poise where he puts head and hands into his work in equal measure, the veteran is good for many years of valuable service as part of the backbone of his industry.

Where Our Industries Stand

It is wholly possible that the difference between victory and defeat will ultimately lie in the extent to which the collective backbone of our essential industries is preserved intact. No industry, of course, can by any chance hope to retain its present payroll without a break. It is not possible to organize armies of the size called for by modern warfare, and to maintain them at full strength against the everlasting inroads of the casualty list, without taking toll from every field of civilian activity. What should be possible is to insure that no industry is crippled by loss of its most valuable workers. The unskilled men, the wielders of pick and shovel, present no problem; we can always find someone to do this work. The skilled workers between the ages of twenty-one and thirty will in any event enlist and be drafted in large numbers; and they must be replaced by enough unskilled workers and inexperienced men to bring the force to its necessary strength. But the skilled workmen above thirty years will not be drafted; and, in every industry upon which the war depends in the least degree, we cannot urge these men too strongly that upon no account whatever should they enlist or in any other manner abandon their present work. We can, if we must, borrow from the future by dispensing with the younger element of our skilled labor, and we can do this without serious present embarrassment. If at the same time, however, we are to lose the older men also, we are headed straight toward disaster. These men can avert industrial chaos only by sticking to their present jobs, prepared to play a double rôle.

In the first place they are needed to keep the works running at or above normal capacity. It requires no argument to demonstrate that if a goodly proportion of the skilled workers of a given industry are about to be removed, the balance of the men must remain if the industry is to be kept in running order. In the second place, it is only by continuous and painstaking effort on the part of these older and more experienced men that dilution of the body of skilled labor with unskilled and green men can be effective. It matters little whether he be an expert linotyper out of a job, a gilder seeking more useful employment for the term of the war, or a common laborer who has shown more than average intelligence with a crowbar; the bald fact is that a man who has never worked at a drill cannot step up to a drill and begin, without instruction, to operate it satisfactorily. Further discussion and example seem superfluous; it must at once be obvious that unless the veteran backbone of our war industries is kept practically intact, the necessity for replacing the younger workers and at the same time keeping up production, can only lead to demoralization.

The Contribution of the Man Who Stays on the Job

Moreover, it is not enough that these experienced workers simply remain at work and do their old tasks in the old way. They must be prepared to do their utmost to help out the green hands—to give them ungrudging instruction, advice and assistance. They must be prepared, individually as well as collectively through their unions, to accept the necessity for dilution.

It is very easy to criticize and denounce the efforts of the other fellow to turn the war to his own personal profit; it is even easier to do this very thing one's self, under the honest impression that one is seeking only what is one's just due. Of course, if production is to be increased and working staff can be kept down, a very juicy overtime melon is in prospect for the closed shop worker; but he cannot cut it without serious injury to the country, and in the long run even to himself.

The labor organizations must then follow the lead of the English unions in waiving, for the period of the war, all closed shop agreements, all contracts that bar the use of unskilled and uninitiated men on certain work. If any union, through its officials, refuses to do this, with talk of entering wedges, employers' plots, and the like, these officials must be repudiated by the rank and file. And individual workers must receive these uninitiated workers, not as "scabs" or intruders or rank outsiders who do not "belong," but as fellow Americans anxious to do their bit, and entitled to all possible aid in doing it.

The Favored Industries

So much for general principles. But even less than the engineer can the mechanic be expected to have a definite vision of the war-time value of his product; so a brief bill of particulars is in order. Now, even if it were possible to catalogue here the thousands of different skilled operations, it would be futile to do so. The man whom we watched the other day making cores for the differential housing of a well known motor truck was doing work of genuine war-time value. The pattern-maker in the next room, who was chiseling out the low spots on an ornamental inkstand, was not. Yet the comparison might have been reversed by putting the pattern-maker at work upon a ship's propeller and transferring the core-maker to something as trivial as the inkstand. The only general statement that could be made about these men is that their foundry is capable of war-time work of greatest consequence, and that, therefore, they are both indispensable during the war—not because they make cores or patterns, but because they are necessary adjuncts of the foundry. Similarly, throughout the industrial world, we must classify a man's war-time usefulness, not according to the particular thing that he does, but according to the industry in which he does it.

Starting our argument on these lines, we see at once that mines, smelters, blast furnaces, steel mills, rolling mills, all other plants which have a part in the production of metal in pigs, ingots, bars, etc., must on no account be crippled. Foundries, forges, wire mills, and other establishments for the conversion of these raw forms are of equal importance. Machine shops in which finished pieces are produced play a vital part. Whether the foundry and the machine shop form an independent unit, or whether they constitute merely departments of automobile factory, ship yard, gun and munitions works, etc., makes no difference. The broad general statement may be made that every large establishment engaged in the production of raw metals, metal parts or finished goods containing metals either is now working on war orders or can be, with little or no re-equipment, set to work on war orders. Every skilled worker in any such establishment who escapes draft is therefore needed right where he is.

The food of the modern army and, in increasing measure, that of the modern civilian, is factory-made. The soldier must be clothed in complete comfort, and even the hapless civilian, while he can cut down on his wearing apparel, cannot go naked. So our flour mills, our canning and preserving factories, our great meat-packing plants, our textile mills of every description, must be kept going. In many of these the proportion of skilled operatives is small; in the great spinning mills, for instance, one girl tends 12,000 spindles. But automatic machinery, while it can be operated by cheap and unskilled hands, requires stationary engineers to keep it running and machinists to keep it in running order; and the fewer of these men there are in a given industry, the more indispensable these few become. Such skilled labor as is employed in our food and clothing factories cannot by any possibility be dispensed with.

Food, clothing, machinery and implements of battle; are these the extent of our war-time needs? By no means. We must have paper; we must have rope; we must have ink and paints; we must have medicines and surgical appliances; we must have leather; we must have electric light; we must above almost all else have transportation and telegraphic communication. Even if we would, we could not specify, within reasonable limitations of space, just what skilled labor enters into the production of every one of these items. Even if we would, we could not hope to compile a complete list of our war-time needs, in order of their urgency. The most that we can hope to do is to make fruitful suggestions. The most that we can hope to accomplish by these is to awaken the skilled labor of America to the fact that before enlisting for active service, before going to work in a shell factory, every American citizen should ask himself whether he can not do better for his country by continuing his present work, and whether, if the answer be "Yes," he dare disregard it.

WE have urged the engineers to bend their energies to the maintenance of the processes and the design and construction of the machinery upon which the war depends. If they follow this advice with substantial unanimity, a long step toward successful conduct of the war will have been taken; but this step will be rendered useless if it turns out that all the men competent to carry out the processes and operate the machines have been put in uniform and sent off to the front on military service.

Accordingly the mechanics and the skilled workers of every description must restrain themselves, as well as the engineers. While a few callings will doubtless be draft exempt, this will not be the case in general. With many skilled workers under thirty being thus taken, it will therefore be doubly necessary for those over thirty to retain their places in the industrial fabric. Only so can complete breakdown be avoided and our industries enabled to support the war.—EDITOR.

Old-Time Sea Fight in the English Channel

(Concluded from page 525)

her and fled with the "Swift" in pursuit. The "Broke" attacked the second German boat in line, torpedoed her, and opened with every gun that would bear. The commander of the "Broke" then swung his boat around to port and rammed the third German boat abreast the after funnel. While the two boats were locked together they fought a desperate hand-to-hand conflict. The "Broke," larger and standing higher out of the water than the German craft, swept the enemy's deck at point blank range with everything, from 4-inch gun to revolver, that she could bring to bear. The fourth and fifth German destroyers opened fire on the "Broke," whose foremost gun crews were reduced from eighteen to six men, and in the midst of this fight midshipman Donald Giles, although he was injured in one eye, continued to keep the foremost guns in action, himself assisting the crews to load. It was at this time that a number of the Germans swarmed up over the "Broke's" bow and swept aft. The little chap stood his ground amid the dead and wounded of his own gun crews and was ultimately rescued by his own crew, who worked their way forward with cutlass and bayonet and captured or drove the boarding party over the side. A few minutes after ramming the enemy boat, the "Broke" wrenched herself free from the sinking ship, and, turning, attempted to ram the last in line of the three remaining Germans. She failed in this, but managed to get home a torpedo on the stem of another boat.

Such fighting, of a truly military character, as is now taking place (the German U-boat attack on merchantmen is not military, but piratical), seems to be confined largely to destroyer actions in the North Sea and the Channel, several of which have been recorded during the past few months.

Making Flags for Our Warships

(Concluded from page 521)

of the smallest of the Latin countries seemingly make up in elaborate emblems what they lack in power, for they have the most gorgeous and figure-bedecked flags of the world. The official flag of San Salvador is very expensive to make, while the dragon flag of China consists of 200 separate pieces which must be carefully joined together, basted and stitched.

When a flag is finished, a heading is sewed on, and the border is stamped with the name of the flag. After it has been critically inspected and passed by the master flag-maker, it is delivered to the general storekeeper of the navy yards. Here it is held until sent out to float from the mast of a commissioned ship or high above some Government building or Army post.

India's War Flower

THE munitions output of India has in two years been increased a thousand fold, mainly through the discovery that one of India's commonest blossoms, the flower of the mahua or mhowra tree, contains acetone in quantity. This tree is well-known to all travelers in Britain's Asiatic empire, but its use as a base for explosives is at least one thing new under the sun.

When the war broke out, acetone, which forms the chief ingredient of cordite, was extracted mainly from wood, maize, and starch; and the British Admiralty erected a great factory for the process of acetone recovery from starch. But fortunately two English scientists in Hyderabad discovered that the mahua flowers contained acetone in large proportions than it is found in any other vegetable substance—that this inoffensive bloom was ten times richer in the material in question than any known wood. In fact, the Director-General of Ordnance for India reports that the mahua is by all odds the best source for acetone known.

Manufacture on a large scale is now under way, and it is whispered that the abundance of munitions with which the British forces in Mesopotamia appear to be blessed is to be attributed to the new discovery.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application, to the Advertising Department of SCIENTIFIC AMERICAN.

Pertaining to Apparel

CUFF LINK.—M. SAPO, 40 W. 28th St., New York, N. Y. This invention relates to cuff links. The eyes of the buttons extend sufficiently into the link to bar a material displacement of the housing on the link, thus insuring that the housing will not be displaced accidentally on the link to expose a gap.

HAT PIN.—M. STRICKLER, care of The Dorothy Millinery Parlor, 757 Westside Ave., Jersey City, N. J. This invention relates particularly to an arrangement which is designed to be manipulated after the hat has been placed in position, and has for an object the construction and arrangement of parts whereby, when the parts are manipulated, the hat is positively secured to the head.

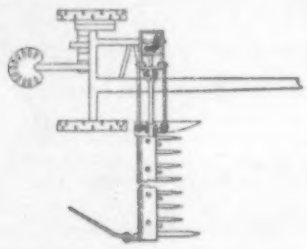
Electrical Devices

TELESCOPIC MAST.—M. GUICHARD, 7 Rue Duranti, Paris, France. The invention has for its object a telescopic mast or post support applicable in all cases where it is desired to produce or receive electric actions. The apparatus may serve particularly for wireless telegraphy or telephony, for the reception of electric atmospheric actions and for all applications of the same kind.

RECEIVER HOLDING ATTACHMENT FOR TELEPHONES.—J. F. WILLIAMS, 52 Vanderbilt Ave., New York, N. Y. The general objects of this invention are to provide a receiver holding attachment adaptable for desk or wall telephones, whereby the receiver is mechanically supported so that the user may have his hands free for writing or any other purpose.

Of Interest to Farmers

FINGER BAR FOR MOWERS.—C. A. JOHNSON, 3010 Upper Stockton Road, Sacramento, Cal. This invention provides an arrangement of cutting members which correctly strike the grass or vegetable matter to be cut and without in any way interfering with the remaining



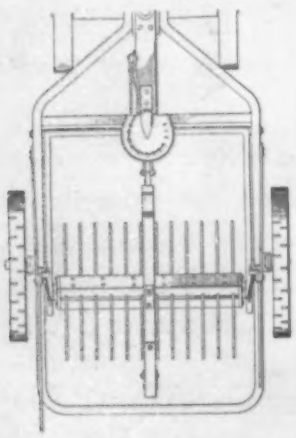
FINGER BAR FOR MOWERS

parts of the device. It provides a finger bar in which the alternate cutters rotate in a different direction, the position of rotation of these cutters being such that one cutter will overlay the other cutter during the cycle of rotation though never coming in contact.

GRAIN SHOCKER.—O. B. PETERSON, Jackson, Minn. The purpose of the invention is the provision of an arrangement adapted to be connected to any suitable harvesting machine so that the bundles in the harvesting machine may be accumulated on a suitable platform and then discharged in a proper upright position.

PLANTER MARKER.—E. T. CARNS and A. R. BISHOP, Murray, Iowa. The improvement relates to planters, as for corn, and provides a marker as an attachment for a planter to supplant the check wire or rope now in common use, and also provides means for automatic operation, and means for throwing the marker out of operative position if desired.

REVOLVING RAKE.—A. R CLAYTON, Via Elko, North Fork, Nev. This invention provides a rake for gathering sagebrush and similar undergrowth, said rake embodiing a wheel supported



REVOLVING RAKE

frame, a second frame movable with relation to the first and carrying teeth, means to adjust and maintain the teeth in spaced relation with the ground and means for elevating the second frame.

TRACTOR.—A. W. JACOBS, Meade, Neb. This tractor is particularly well adapted for use on corn fields, the tractor being so constructed that it may be used not only for drawing planters across the fields but it also may be used to advantage for drawing cultivators without injury to the growing corn.

Of General Interest

DRUGGIST'S CABINET.—H. L. MARBURGER. Address Reinle-Salmon Co., cor. Warner and Ostend Streets, Baltimore, Md. The improvement is in druggist's cabinets containing rows of boxes or drawers arranged contiguously and adapted to be drawn out and turned laterally to expose their open sides and render their contents accessible. It pertains particularly to means for supporting the drawers while in normal position in the cabinet, also when being pulled out and turned to a lateral position, whereby greater strength and economy of construction are attained

TREATMENT OF LIGNITE AND THE LIKE.—T. RIDDY, 61 Loreburn St., Dumfries, Scotland. The present invention consists broadly in effecting removal of moisture from lignite or the like by pulverizing the material and introducing it into a stream of hot products of combustion by which it is dried to a certain extent and conveyed to the desired locality such as to Schulze driers in which the material is then further dried.

SHOCK ABSORBER FOR PNEUMATIC TOOLS.—W. C. SIMPSON, JR., and J. P. BARBOUR, Address the former 107 South C Street, Livingston, Mont. This invention has for its primary object the provision of a shock absorbing device capable of connection with standard pneumatic tools for absorbing the shock of action of the tool to prevent transmission of the same to the operator thereof, the main consideration being the elimination of all shocks and jars to such operators of such implements and the preservation of health.

CIGARETTE CASE.—W. DIETZ, 20 Maiden Lane, New York, N. Y. This invention has for its object the provision of a cigarette case which may be readily filled, and which may be conveniently opened to exhibit the cigarettes which, by means provided may be raised from the case, one or more as may be desired.

MEDICINE CARD.—A. E. AINSLIE. Address J. E. Reiger, Atty., Kirksville, Mo. The card hangs on the wall of a sick room and is provided with a scale representing the divisions of time, and a series of marking means or indicators for coöperating with the scale to indicate certain predetermined hours or other divisions of time, the said indicators being distinguished from each other by difference in color or the like to represent different medicines to be given, and wherein the card and indicators have coöperating means for permitting the indicators to be supported at predetermined points of the scale.

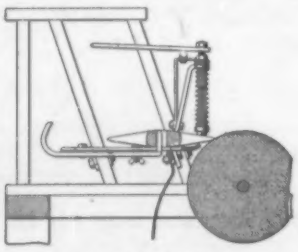
Hardware and Tools

LATCH.—L. W. HOLLAND, Pleasant Hill, Mo. An object of this improvement is the provision of a latch having a detent which engages a strike-plate so as to release the latch-bolt and permit the latter to move forwardly into locking position, said latch-bolt and said detent being operated by a single spring.

MOUNTING FOR GLASS CUTTERS.—S. G. MONCE, Unionville, Conn. This invention relates to glass cutters of the cutting wheel type, and provides a new and improved mounting in which the glass cutting wheel is journaled, the mounting being very simple and durable in construction and readily attached to or removed from any desired form of holder.

ADJUSTABLE FLOATING REAMER HOLDER.—R. RAILTON 391 High St., Valley Falls, R. I. This invention provides adjustments of the reamer holder which together with the floating of the reamer will enable accurate reaming to be attained. It provides against the dropping of the spindle out of line with the turret, and also against the wear of the turret slide sidewise and at the bottom.

MILL-PICK JIG.—A. MROZINSKI, 187 Jersey St., New Brighton, Richmond, S. I., N. Y. This invention relates to a contrivance for presenting mill picks at a proper angle to a grindstone and to automatically regulate the amount of grinding of



MILL-PICK JIG

the pick on the stone. It provides a simple and inexpensive contrivance which can be easily adapted to a grindstone, which will require little attention and will permit the grinding of a number of picks at a time.

DOOR CHECK.—F. P. FAIRBANKS.—Box 53, Point Pleasant, N. J. This invention provides a device which positively prevents a door from closing accidentally and thereby causing injury to a person having his fingers at the jamb. It provides a check which will prevent the closing of the door unless the door handle or knob is operated. It also provides a check which will allow the door to move freely from the jamb without the operation of the handle.

MATCH BOX.—E. A. FRANKLIN, Fort Collins, Colo. This improvement provides a match box having a sliding cover, which in its extended position will form a wind shield, and so facilitate the lighting of a cigarette, pipe, etc., in a high wind. It provides a wind shield with suitable openings through which a match may be inserted to engage a scratching surface, and at which a pipe, cigar, etc., may be lighted.

NUT LOCK.—C. L. CRAIG, Washington Court-House, Ohio. More particularly the invention relates to a nut lock consisting of a nut engaging, bolt carried washer capable of quick and ready manipulation to effectually engage and hold a nut irrespective of the particular position of the latter with respect to the bolt.

CALLIGRAPHIC DEVICE.—J. M. REARDON and E. B. BERGESON, address the former, Chico, Cal. This invention has reference more particularly to a device for insuring correct and normal penmanship. More specifically it relates to a device which comprises a body having means for attachment to a writing implement and means for effecting the proper positioning of the fingers relative to the instrument.

Heating and Lighting

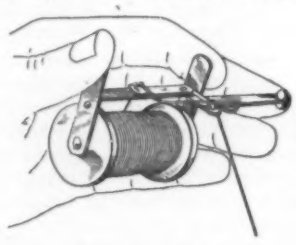
AUTOMATIC DAMPER REGULATOR.—W. T. HOGG, address Riverside and Dan River Cotton Mills, Inc., Danville, Va. This invention provides a means for regulating the draft in the flue or chimney of a steam generating plant according to the boiler pressure which it is desired to maintain. The invention is in the nature of an auxiliary attachment which co-acts with the weighted lever of a water regulator proper to effect the speedy regulation desired.

OIL BURNER.—B. J. LATSHAW, address ALLDAY & ALLDAY, Attorneys, Burkburnett, Tex. This improvement has for its object to provide a burner wherein mechanism is provided for spraying a mixture of steam and oil into the furnace, in such manner that the oil and steam will be thoroughly mixed and atomized before it is delivered to the furnace.

Household Utilities

WASHTUB COVER.—J. I. LEVETT, 116 W. 144th St., New York, N. Y. Among the principal objects which the present invention has in view are: the provision of a cover, the vertical section whereof may be reduced; to provide a shelf at the back of the tub when the tub is opened for service; and to provide a convenient rack for floor or other cloths.

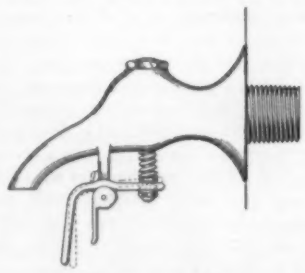
SPOOL ATTACHMENT.—L. J. LECLERC, Au Sable Forks, N. Y. The device has means for mounting a spool in a manner to exert friction on the ends of the spool, and provided with means for holding and tensioning the thread or wire, the



SPOOL ATTACHMENT

whole being arranged to permit of the thread or wire being drawn from the spool by the user while at the same time the thread or wire will be prevented from freely unwinding, as for instance, when the spool is deposited in the work basket or accidentally dropped.

AUTOMATIC FAUCET.—T. COONAN, care of Box 595, St. Charles Hotel, Alamoosa, Colo. This invention provides a self-closing faucet for dispensing vessels, such as coffee urns, water coolers, etc., the valve being operable by the pressure of a tumbler, cap or other receptacle held in position to receive the liquid to be discharged from the



AUTOMATIC FAUCET

faucet; provides an automatic faucet so arranged that no packing is required for the portion of the valve projecting out of the faucet body; and provides the automatic valve with auxiliary means for maintaining the valve off its seat when desiring to drain the container.

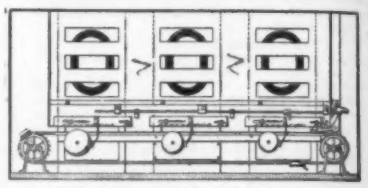
DOOR BUFFER.—D. F. OLIVER, Hotel Statler, Detroit, Mich. This improvement provides a buffer arranged to offer a light resistance to the door on closing the latter quietly, and to offer a heavy resistance on slamming the door, thus preventing injury to the door and doorcasing, and reducing the shock incident to the slamming of the door to a minimum.

WINDOW SHADE BRACKET.—C. M. LANGE, 165 India St., Brooklyn, N. Y. A specific object of this improvement is the provision of a bracket having rigidly fastened thereto a screw so that the bracket can be fastened in place without the use of tools, the body of the bracket being made up of a sheet metal stamping to which the screw is riveted.

Machines and Mechanical Devices

STREET SWEEPER.—M. EDWARDS, Haleiste, N. Y. This invention provides drive means for the rotary brush which will produce an even, steady rotation of the brush; provides an arrangement of boxes for the sweepings and dust and conveniently removable from the body; provides a rotary brush and a co-acting inclined pan so arranged that an air current or suction will be produced, active to carry the dust into the interior of the body with the sweepings; and provides an arrangement of screened outlets for filtered air from the interior of the sweeper.

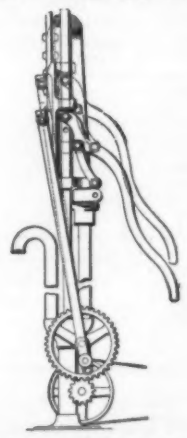
AUXILIARY INDICATING DEVICE FOR CASH REGISTERS.—O. E. GROSHELL, 1083 First Ave., Salt Lake City, Utah. An object of this invention is to provide an indicating device having large numerals, which may be located



AUXILIARY INDICATING DEVICE FOR CASH REGISTERS

in a position in which the numerals may be easily seen by the proprietor or manager of the establishment in which the cash register is being used, and which will display numerals which are duplicates of those brought into view by the operation of the cash register itself.

COUPLING FOR PUMP RODS.—C. ZEHR, Berne, Ind. The invention provides mechanism for connection with a pump, comprising a bracket having uprights with guides for the rod, and a pumping bar of yoke shape and comprising a vertical body on the opposite side of the rod from the uprights, and arms having guide openings for



COUPLING FOR PUMP RODS

receiving the rod and having means for permitting the bar to be connected with a wind mill or a pump jack, the lower arm of the bar being extended between the uprights and adapted for connection with the pump handle, and said handle being arranged to form a rigid brace between the upper and lower arm when in inoperative position.

DIE OR FORMER.—C. M. STEELE, Statesville, N. C. This invention provides a die or former especially adapted for use with brick machines to form the tempered clay into a bar rectangular in cross section from which the individual bricks are cut, wherein means is provided in connection with the die or former for lubricating the bar as it emerges from the former to overcome the excess friction in the corners of the die and across the narrow edge to provide a more perfect and a more homogeneous bar.

SEWING MACHINE NEEDLE GUARD.—P. L. BIONDO, 101 Evergreen Ave., Brooklyn, N. Y. Among the objects of the improvement is the provision of a sewing machine having a vertically reciprocating needle and an associated presser foot, with a guard connected to and carried by the presser foot and presser foot bar to prevent the fingers of the operator from accidentally getting beneath the needle.

SELF-LOADING MIXER.—G. S. ATKINSON, 39 W. Julian St., San Jose, Cal. This invention devises and designs a machine which is self-loading, especially with respect to all the heavier parts of the mixer, means being provided to cause the machine to be self-propelled toward a bulk of sand, gravel or the like, for gathering or scooping up the same and mixing with other component parts such as concrete, water, etc.

TAKE-UP FOR BUSHINGS.—W. H. REAGAN, JR., Miami, Ariz. The purpose in this case is to provide a simple and inexpensive arrangement whereby the wear caused by motion can be easily and quickly taken up without disturbing the throw and without disturbing the alinement of the various machine elements associated with the bushing.

COLOR APPLYING MECHANISM FOR PRINTING PRESSES.—CARL WINKLER, Berne, Switzerland.—Most inking and color applying devices having two or more applying rolls have the disadvantage that the front applying roll only fulfils its function of applying ink or color to the form during the forward movement but not during its back stroke. To overcome this drawback without altering the construction of the machine the steel roll transferring fresh

(Concluded on page 534)

NEW BOOKS, ETC.

A DESK-BOOK OF TWENTY-FIVE THOUSAND WORDS FREQUENTLY MISPRONOUNCED. By Frank H. Vizetelly, Litt. D., LL.D. New York: Funk & Wagnalls Co., 1917. 8vo.; 942 pp. Price, $1.60 net.

This work, a distinct step forward, includes valuable features omitted from other similar aids. Pronunciation is given according to both old and new systems, and the keys are found at the top and bottom of every page, thus obviating the necessity of turning back to refresh the memory. Concise definitions are given, there are abundant historic notes and quotations illustrating usage, and where preferences vary among authorities these preferences are recorded and the authority is cited. It is not to be expected that so enormous a task could have been accomplished without minor lapses and omissions. A number of the words mentioned in the introduction as presenting difficulties are not to be found in the body of the work, among them actinism, rowlock, velleity, coquetry and spontaneity. The author's reference to "'Mourn,' which standard pronunciation has decreed should be the same as 'morn,'" is misleading. On the whole, however, the desk-book, which includes personal and geographical names and proper names current in literature, science, the arts and the news of the day, is a remarkably trustworthy and complete concensus; from numerous severe tests it has emerged with flying colors

BRITISH RESOURCES OF SANDS SUITABLE FOR GLASS-MAKING. By P. G. H. Boswell, A.R.C.Sc., D.I.C., D.Sc., F.G.S. New York: Longmans, Green & Co., 1916. 8vo.; 92 pp.; illustrated. Price, 50 cents net.

The war has spurred England to a minute examination of British sands, in the hope of satisfactorily replacing imported sands the supply of which has been cut off by the war. The investigation has yielded some very practical results which are embodied in this monograph, which is published under instructions from the Ministry of War. There are also notes on certain crushed rocks and refractory materials, and American glass-sands are included in the chemical analyses.

THE LAST WEAPON. A Vision. By Theodora Wilson Wilson. Philadelphia; The John C. Winston Co. 8 vo.; 188 pp. Price, 25 cents.

The author, through her narrative, makes a strong plea for the Christian faith as a means of abolishing war. At this stage of our evolution, however, the weapon of "perfect love" has unfortunately no chance against the weapon of perfect brutality, and in allowing brutality to murder our dear ones and crush the ideals for which our fathers fought we should be untrue to the trust imposed upon us by the Creator; there is a time to place principles above lives; if we throw our lives to the lions we throw, not only our lives, but these sacred principles also. There is much truth in the author's vision—but not truth enough.

HEATON'S ANNUAL. The Commercial Handbook of Canada and Boards of Trade Register. 1917. Toronto: Heaton's Agency. New York: Henry Malkan. 12mo.; 516 pp. Price, $1.25.

To all who have business relations with the Dominion this handbook offers a surprising amount of information in compact form; sound judgment is evident in the selection, and the topical arrangement and exhaustive index assures a ready answer to the inquirer. Among the more important sections of the work may be noted an official directory of the legislature; financial affairs, including banking, exchange, trustee investments, and the standing of insurance companies; commercial regulations as affecting foreign corporations, patents, commercial travelers, and war taxes; transportation, with much information as to railways, fares, and travel distances; a shipper's guide to banking towns; customs information that is especially full and trustworthy; and much material on agriculture, mining and industry, immigration, education, and sport. Governmental officials and the boards of trade coöperate in making the Annual a standard and authoritative commercial guide.

WITH THE FRENCH FLYING CORPS. By Carroll Dana Winslow of the French Flying Corps. New York: Charles Scribner's Sons, 1917. 8vo.; 236 pp.; 16 full page plates. Price, $1.25 net.

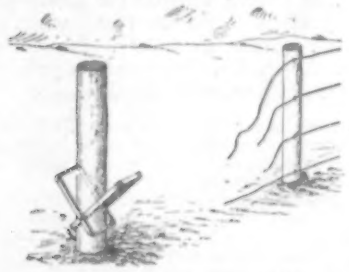
In a story fine in its truthful simplicity, a young American chronicles his life as a recruit up to the time when he played his part with the defenders of the Republic. Modestly enough, he calls his own experience uneventful, but it makes anything but monotonous reading. There are the frequent accidents of the beginners and the death dives of heroes brought down by shrapnel or the rapid-fire guns of enemy aeroplanes; there are Homeric combats in the air in which American valor is successful against odds. No more striking testimonial to the stability attained by the modern aeroplane can be given than the strict command to the learner that, whenever he finds himself in trouble and does not immediately realize what to do, he must let go the controls, shut off his motor, and allow the machine to take care of itself. There are numerous plates of the machines and of the trench-scarred and shell-pitted battlefields. The whole life of the flying man in war is unfolded to the reader, and he has a feeling that he is sharing in the exciting work himself, is himself taking part in the making of history.

RECENTLY PATENTED INVENTIONS

(Concluded from page 532)

ink or color to the front roll applying color to the form is arranged so far toward the front and downward toward the form that said front color applying roll only needs to rotate through a short distance in order to receive fresh color from said steel roll.

HAND, FENCE POST AND STAKE PULLER.—R. S. Fox, Box 325 Blue Earth, Minn. This inventor provides a device especially adapted for pulling posts, stakes and the like from



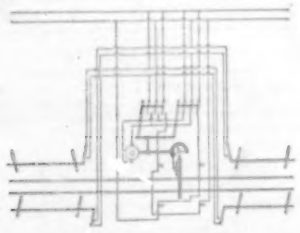
HAND, FENCE POST AND STAKE PULLER

the ground, wherein the pulling mechanism is in the form of pivotally connected open frames adapted to be slipped over the post, each frame having at one end gripping mechanism for engaging the post or stake, and at the other end a handle.

CHANGEABLE DISPLAY BOARD. — J. Locke, 35 Mamaroneck Ave., White Plains, N.Y. This invention relates to changeable sign boards, billboards or like devices, and has particular reference to means whereby a plurality of different display designs may be manipulated along the same apparatus at spaced intervals of time and having characteristics adapting the apparatus for attracting particular attention thereto.

RELIEF VALVE.—C. F. Fritch, 217 Canton Ave., Detroit, Mich. In this invention the improved valve, though capable of a wider use, is more particularly intended for use on range boilers as a safety valve or as a relief valve in case of excessive steam pressure therein. A threaded connection between the yoke and valve casing permits of the yoke being adjusted to vary the tension of the compression spring.

MINE DOOR OPERATING DEVICE.— W. M Hummel, 227 Shaw Ave., Lewistown, Pa. The invention relates to automatic door opening and closing apparatus and deals particularly with an apparatus for opening mine or air chamber

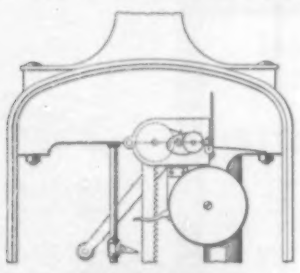


MINE DOOR OPERATING DEVICE

trap doors and for operating signals to indicate the open or closed position of the door, the apparatus enabling the driver of a car to himself look after the opening or closing of a door and thereby do away with the need of boys for this purpose.

FEED DEVICE FOR SEWING MACHINES.—W Cronenberg, 18 W. 18th St., New York, N. Y. This device is more especially designed for feeding two fringe bodies and a bunch of loose strands simultaneously to the stitch-forming mechanism and relatively to each other so that the bunch of strands is tied at intervals and the fringe loops are sewed alternately to the bunch of strands on opposite sides to ultimately produce two fringes each having tassels of approximately spherical shape.

TALLYING DEVICE.—H. H. Patterson, 3 Willow St., Hudson Falls, N. Y. The invention provides a tallying device more especially designed for use on gasoline pumps such as are used in garages or on the sidewalk in front of garages,



TALLYING DEVICE

and arranged to furnish accurate records of the amount of gasoline passing through the pump and delivered to the various customers, thus enabling the proprietor to make the proper charges against the customers or buyers of the gasoline.

PULLEY.—J. B. Dunlap, 618 N. Boston Ave., Tulsa, Okla. The purpose here is to provide a pulley of the sectional type wherein a form of connecting means is provided for connecting the sections, and a form of bushing for tightening the pulley on the shaft controlled by the turning of the bushing with respect to the pulley.

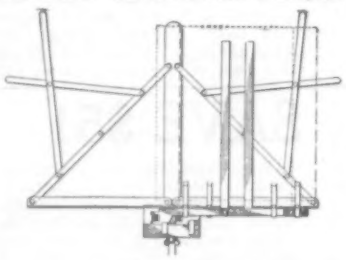
CLUTCH.—E. Williams, 17 Sandon Road, Edgbaston, Birmingham, England. The invention comprises the combination with a pair of internally coned outer clutch members freely mounted on a shaft, and a single inner clutch member feather-keyed to the shaft and provided with a pair of oppositely coned parts which can separately engage the corresponding outer members, of a central sliding sleeve which can impart movement to the inner member through a spring and a central rod attached to said member, and a pivoted thrust piece which can impart movement in either direction to the sleeve from another central rod.

WHEELED SCRAPER.—M. V. Liddell, 1303 South 4th St., Springfield, Ill. Among the objects of this improvement is the provision of a machine of the excavating or road type, which is more simple and compact with reference to the hoisting devices and also including an auxiliary hoist whereby the scoop may be elevated when the machine is at a standstill.

Musical Devices

TALKING MACHINE RECORD.—E. T. Frankel, 506 W. 135th St., New York, N. Y. In the present patent the invention has reference to disk records for talking machines, and has for its general object to improve the record in a simple and inexpensive manner so as to increase the effective record space or the duration of the sound reproduction for a given area.

MUSIC LEAF TURNER.—H. J. Bailey, Dickenson St. and N. Alden Ave., Trenton, N. J. This invention has particular reference to devices for holding and automatically turning the leaves of sheet music. The construction is adapted to

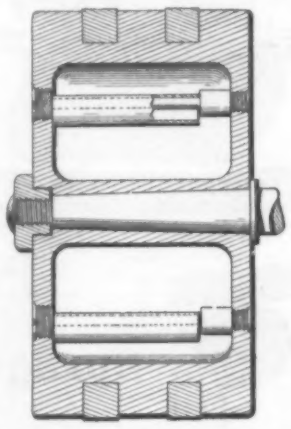


MUSIC LEAF TURNER

be secured either upon a music rack of ordinary nature or upon a piano casing or other stationary support. The invention also provides a means which will hold the music leaves securely and yet not damage the same.

Prime Movers and Their Accessories

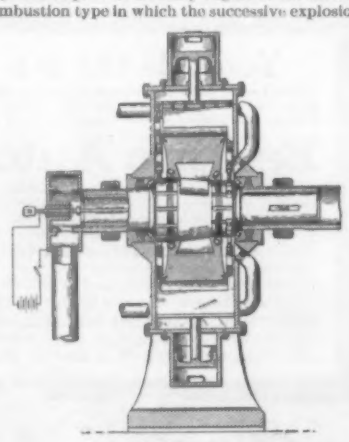
PISTON HEAD.—B W Beery, 1250 18th St., Portsmouth, Ohio The present invention is an improvement in piston heads, and has for its object the provision of a mechanism in connection



PISTON HEAD

with the plugs of piston heads, for preventing the accidental dislodgment of the plugs when they are once in place. The engraving shows a longitudinal vertical section of a piston head provided with the improved plugs.

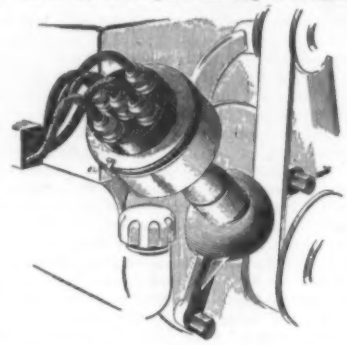
ROTARY ENGINE.—E. M. Long, Oak City, N. C. An object here is to provide an efficient, comparatively non-gyroscopic engine. Another object is to provide a rotary engine of the internal combustion type in which the successive explosions



ROTARY ENGINE

are so frequent that the resulting combustion of the fuel may be said to be continuous. A further object is to provide a rotary engine in which the direct impact of the explosion, as well as the expansion potential of the igniting gas, is utilized.

AUTOMATIC SPARK TIMER FOR INTERNAL COMBUSTION ENGINES.—J. J. Herzog and W. M. Medlock, care of Herlock Automatic Ignition Co., Mobile, Ala. One of the several objects of the invention is to provide a device by means of which the ignition spark of an internal combustion engine may be so timed that no matter at what speed the engine is running

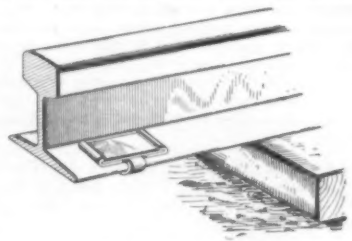


AUTOMATIC SPARK TIMER FOR INTERNAL COMBUSTION ENGINES

the cylinders will be fired at the precise moment to give a maximum efficiency. A further object is to provide a device for use on automobiles, thereby obviating the necessity of manual manipulation of the spark lever, so that an automobile may be run at a very low speed or at a high speed or at intermediate speeds without unevenness or jerking of the car due to failure to shift the spark lever to the proper position.

Railways and Their Accessories

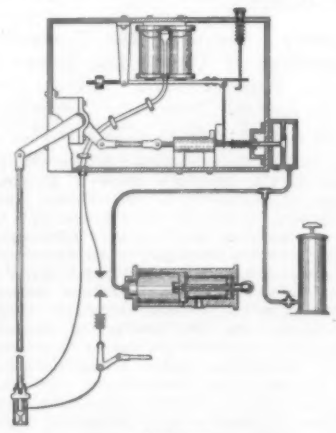
RAILROAD STAKE.—W. P. Newkirk, Box 150, Portsmouth, Ohio. This invention is an improvement in railroad grade and elevation stakes, and provides a stake consisting of a holder for the plate carrying the grade and elevation



RAILROAD STAKE

indications and adapted to be engaged with the base flange of the rail between adjacent ties, in such manner that the holder and plate will be superposed upon the base flange at one side of the rail in convenient position to be consulted.

TRAIN STOP.—H. B. Colsten, Great Bend, Pa. This improvement relates to apparatus for automatically stopping a locomotive, train or car if the same is not stopped upon receiving a danger signal. The invention improves and simplifies the construction and operation



TRAIN STOP

of train stopping apparatus so as to be reliable and efficient in use, comparatively easy and inexpensive to manufacture and install, and so designed that it is entirely automatic in its operation, except as to the setting of the parts after the train has been stopped.

Pertaining to Recreation

GAME DEVICE.—M. Gurtov, 417 Claremont Parkway, New York, N. Y. This invention relates to toys and games for children, and provides a device which may be used as a doll or toy, as an

GAME DEVICE

effigy of a bear, although it may represent other animals, and which may be used at will as a game device in conjunction with one or more playing balls.

MOVING PICTURE FILM REWINDING APPARATUS.—W. O. Worman, care of Boyd, Devine & Eccles, Ogden, Utah. This invention has for its general object to provide a rewinding device of comparatively simple, inexpensive and durable construction, embodying a fireproof box for containing the reels, in combination with an electric motor drive for operating the reel on which the film is rewound.

Pertaining to Vehicles

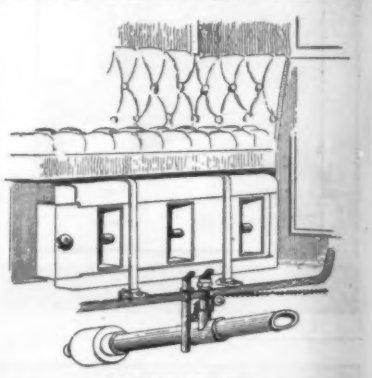
TAIL LIGHT.—A. W. Morford, New Monmouth, N. Y. Mr. Morford's invention pertains to a tail light embodying two independent light sources controllable from the seat of the driver of a vehicle. He provides a tail light which carries an auxiliary searching light adapted to be rendered operative independently of the tail light when backing the vehicle.

LICENSE SIGN FOR AUTOMOBILES.—H. Brewster, 8 East 12th St., New York, N. Y. This invention relates generally to license signs of automobiles, and more particularly to a rigid sign which may be plainly seen both in daylight

LICENSE SIGN FOR AUTOMOBILES

and at night, the object being to provide a license sign by which unwarranted change of numbers or removal thereof in case of accident, overspeeding or law-breaking expeditions may be entirely prevented.

AUTOMOBILE HEATER.—T. C. Crouch, Address Lynd, Gilchrist & Hogarth, Canada Bldg., 4th floor, Saskatoon, Saskatchewan, Canada. This improvement has particular reference to a heater controlled by the exhaust from the engine. The heater casing is adjustably mounted upon a suitable support in the vehicle



AUTOMOBILE HEATER

whereby the same may be moved to a position preferably beneath a seat and also adjusted in such a manner as to be employed as a foot-warmer. The invention provides a heater casing wherein a system of heating pipes is connected to the exhaust of the engine and the flow of burnt gases through said pipes regulated by a valve mechanism controlled by the operator.

SIGNALING DEVICE FOR AUTOMOBILES.—E. C. Cox, care of Hotel Norris, Easton, Md. This invention relates to improvements in signaling devices for automobiles and provides a signal which may be located at the rear of the vehicle, as for instance on the fender, said signal being normally out of view but being arranged to be brought into view immediately by the pressure of a push button.

METHOD OF REMOVING BUSHINGS FROM SPINDLE BEARINGS.—R. E. Yarckel, General Delivery, Honolulu, Hawaii. This invention comprises a method of removing one of a pair of spaced apart bushings extending into opposite ends of a spindle bearing. It is particularly applicable to the Ford automobile for removing the bushings of the spindles of the front axle when the bushings have become sufficiently worn to require it.

DEMOUNTABLE RIM.—J. W. Drummond, 687 E. Main St., Chillicothe, Ohio. The primary object here is to provide a rim which may be readily associated with, and disassociated from, a tire, embodying hinge sections, the free ends of which are so formed as to lock and unlock substantially in an automatic manner, and to defeat all danger of accidental displacement when tire inflated pressure is applied thereto.

SHOCK ABSORBING BODY BRACE FOR AUTOMOBILES.—R. M. Musgrove, care of Motors Supply Co., 7th and Minnesota Aves., Kansas City, Kansas. The general object of this invention is to provide an attachment for automobiles, particularly the Ford, to firmly brace and sustain the body thereof, at the center, whereby to absorb and relieve the body, including the running boards of strain and jar due to the vibrations and sagging of the body and running boards at the center.

Note.—Copies of any of these patents will be furnished by the Scientific American for ten cents each. Please state the name of patentee, title of the invention, and date of this paper.

Our National Waste

AMERICA stands at the bar indicted as the world's most wasteful nation. The famous Wall Street leak which aroused so much discussion proves to be only a drop in the bucket compared with the preventable losses suffered each year by the American people. Leaks of tremendous proportions have been going on year after year, with little or no attempt to check them save on the part of public servants and interested persons.

It is estimated by experts who have made a study of the losses suffered by the country, through various causes, chiefly indifference, inefficiency and carelessness, that these leaks will amount to more than $10,000,000,000 annually, with the probability that it is even higher. Only those things which may be classed as more or less preventable leaks are classed in this list. The total sum of these losses is sufficient to pay England's war expenses for nearly five hundred days, or to foot the French war bill for approximately 1,000 days. No other country than the United States could suffer such losses and escape bankruptcy.

Property Losses

The inefficiency and carelessness which lead us to neglect proper safeguards against the destruction of our property by natural forces (fire, rusting and other chemical action, electrolysis, needless wear and tear, etc.), are the causes of a physical and economic leak which is sufficient to pay the expenses of running the United States government for a period of two years or more. The loss to factories and the workers themselves through inefficiency and carelessness is in itself a stupendous sum, while the exercise of a little more care would save hundreds of millions of dollars' worth of property destroyed by fire each year. The farmers allow $100,000,000 worth of farm machinery and equipment to rust and decay each year, and the deterioration of physical property in the cities due to carelessness is even larger. A most conservative estimate of the amount of this leak is $2,500,000,000. There is reason, however, to believe that it is twice as much.

What We Drink Up in A Year

Each year the American public consumes approximately $1,500,000,000 worth of intoxicating liquors, practically all of which represents a loss. Nor does this include the enormous amounts expended each year to maintain criminal courts, hospitals, jails and other institutions made necessary by the "booze" habit. The burden of caring for helpless and needy families of the offending drinkers also represents a most important leak in the country's resources. The experience of the European nations in the war makes untenable every stand taken by the defenders of a man's right to make himself a liability instead of an asset to the community. The people of the United States could save more than $2,500,000,000 annually if they followed the course thus indicated.

The Food We Buy and Fail to Eat

Managers of the large hotels testify that one-fifth of the food they buy is wasted by the public. This in itself is a leak of no inconsiderable proportions, but there are other items in food waste which are even more serious. Domestic science experts testify that approximately twenty per cent of the money the average family expends for food is wasted through improper selection and marketing and poor cooking. In other words, the American people waste more than $1,000,000,000 worth of food each year. Waste and illegitimate profits in growing and marketing produce and other foods amounts in addition to more than $1,000,000,000 annually, according to officers of the National Conference on Marketing and Farm Credits at their last meeting.

The Doctor's Bill for Man and Beast

The doctor, of course, is an excellent person, in his place; but each year the American people lose more than $1,000,000,000 because of sickness and accidents which might have been prevented by the exercise of a few precautions. More than 30,000 workmen are killed and 300,000 are seriously injured each year in the industries

alone. Then, too, each of the 30,000,000 workers in the country loses approximately nine days each year due to sickness. This is a wage loss of more than $500,000,000, and does not include the loss suffered by industry. Doctor and nurse bills in such cases total approximately $200,000,000. More than 3,000,000 persons are ill on any day in the year, and of these 500,000 are suffering from consumption, a preventable disease.

Animal diseases, such as hog cholera, the foot and mouth disease, etc., are costing the farmers and the general public an enormous sum each year, although agricultural leaders have been waging an effective fight upon such epidemics. Ultimately the farmers will be enjoying the use of about $200,000,000 which they now lose each year through these causes.

Insects and Other Guests

Of all the numerous pests that have been allowed to gain a foothold in the United States, the insect class has been the cause of the greatest damage. Such insects as the gipsy moth, boll weevil, cattle tick, mosquitos, flies, etc., destroy crops worth approximately $1,000,000,000 annually, according to officials of the Department of Agriculture. The cattle tick alone is said to cause more than $200,000,000 loss each year. While it is not possible at this late day to eradicate these pests entirely, they can be controlled to such an extent that the damage they do becomes very small when compared to present losses. Sickness and destruction of physical property brought about by insects also amounts to a leak of many millions.

Members of the rodent class—rats and mice and kindred animals—are responsible for an enormous loss each year in crops and property destroyed. Diseases carried by rats have been the cause of many deaths and the expenditure of millions to check the spread of the plagues. A conservative estimate of the loss caused by the rodents is $200,000,000. Most of this could be prevented by the extermination of the pests.

The house sparrow, or the "avian rat" as he has been termed, is responsible for one of the biggest leaks suffered by this country. Numbering one-fifth of the total bird population, it requires an enormous amount of good seeds, fruits, buds and young vegetables to feed the sparrow tribe. Although he has been supposed to be an eater of weed seed, investigations made by biologists have resulted in the condemnation of the sparrow, which was imported from Europe sixty years ago, as the country's worst pest. In addition to killing off the song birds, the sparrow does damage of approximately $100,000,000 each year.

The Cost of Bad Roads

The farmers of the United States have been allowing $300,000,000 in real money to escape from their pockets each year because of poor roads, according to the testimony of experts who made a survey of the effect of bad roads upon markets for the Department of Agriculture. Just when the farmer has the opportunity to market his crops at top prices, bad weather closes the roads to heavy hauling and he must wait until another season. To the loss of the farmers must be added an economic loss equally large suffered by the nation. If the rural roads could be used for traffic the year round, Uncle Sam would save more than half a billion dollars. This is a typical bad road blockade which exists for weeks and often months in rural districts.

A Billion Dollar Trash Heap

The family trash pile stands as a glaring indictment of the extravagant and wasteful habits of the average American family. Each year the average family throws away enough materials and supplies of various sorts to enable the junk dealers and waste material men to do a business of more than $1,000,000,000. This enormous business has been built up out of waste pure and simple, and represents a total loss to the country. Even, discounting the extravagant profits of the junk man, who pays little or nothing for the things he buys, the American people throw more than $200,000,000 out upon their trash piles each year.

YOU are about to buy a car. On that car, you naturally would like to have a Delco system —starting, lighting, and ignition. You can get it—Delco quality—absolute dependability.

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